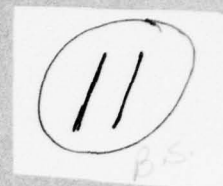


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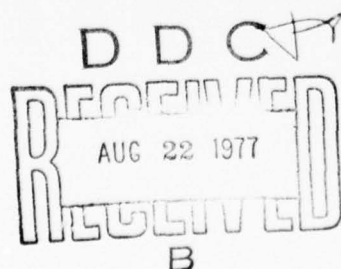


**A SURVEY AND ANALYSIS OF MILITARY
COMPUTER-BASED TRAINING SYSTEMS:
(A TWO PART STUDY)**

**VOLUME II
A DESCRIPTIVE AND PREDICTIVE MODEL FOR
EVALUATING INSTRUCTIONAL SYSTEMS**

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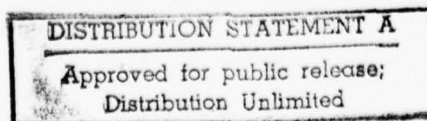
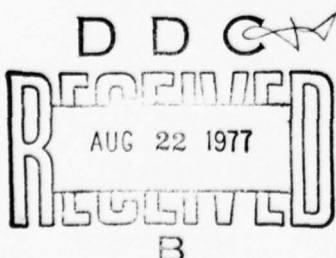
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20. ABSTRACT (Continue on reverse side if necessary and identify by block number) The objectives of this study were: (1) to examine the literature to identify authoring aids for developing instructional materials and to identify informa- tion clearing houses for existing instructional materials; and (2) to develop a generalized, computer-based model of a self-paced instructional system that can be used to determine expected time-savings and costs of self-pacing as com- pared to conventional instruction. The purpose of Part I, reported in Volume I, was to examine the ISD concept as it relates to the authoring process and analyze tools and procedures which facilitate the ISD process. The purpose of		

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Part 2, published in Volume II, was to develop a means for assessing the cost versus expected benefits of innovations in computed-based training systems. A three-pronged approach was used to address the problem. First, a descriptive model of a generalized, computer-based training system was developed. Second, a predictive model was generated to describe student performance in a computer-based training environment. Third, a computer program incorporating the predictive model was developed to estimate the cost of implementing one particular training innovation, i.e., revision of a conventional instructional program into a self-paced instructional program. A linear prediction model was developed to predict the time required for a student to complete a unit of self-paced instruction thereby demonstrating the time saved by converting from a conventional instructional mode. This was combined with the Rand Corporation's MODIA cost analysis program. The study demonstrated that a viable time savings and cost model can be developed given a sufficient data base from which to draw the necessary course content and student characteristics descriptions.

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PREFACE

This study was conducted under Contract MDA-903-76-C-0086 with the Department of Defense, Advanced Research Projects Agency, Cybernetics Technology Office. The DoD Program Manager was Dr. Harold F. O'Neil, Jr. The Principal Investigator was Dr. Robert A. Vecchiotti, McDonnell Douglas Astronautics Company - East (MDAC-EAST).

The contributors to this report are listed in alphabetical order: Dr. Donald W. Carver, Mr. Edmund H. Conklin, Drs. Donald R. Hesser, Wilson A. Judd, Barbara L. McCombs, George D. Siering, and Robert A Vecchiotti. The contributors wish to express their appreciation for the cooperation and suggestions of personnel from the Air Force Human Resources Laboratory - Technical Training at Lowry Air Force Base, Colorado, and to their colleagues on the Air Force Advanced Instructional System Program for their contributions, particularly Mr. William H. Stobie. Special thanks are due to Ms. Polly Carpenter-Huffman of the Rand Corporation for arranging the use of the Method of Designing Instructional Alternatives (MODIA) cost model.

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PROBLEM

Within the context of military training system development, the question of how to assess the cost versus expected benefits of innovations in training technology has become of major importance. Before this question can be answered, it must first be demonstrated that both the cost and the benefits of such innovations can be quantitatively measured. Then it must be demonstrated that accurate predictions can be made with regard to development and operational costs, training effectiveness, and expected timesavings.

APPROACH

Three separate activities were undertaken to solve this problem. The first was to define a descriptive model of a generalized, computer-based training system. This model defined the domain of such systems to be addressed by a predictive model. It also identified the component activities involved in such a training system, isolated seven clusters of factors which would impact the operation of the system, and identified the relationship of each cluster to the separate component activities.

The second step was generation of a predictive model of student performance in a computer-based training environment. The purpose of this model was to predict the time required for a student to complete an arbitrary unit of instruction in a self-paced training program given only characteristics of the student, of the content taught, and of the method employed to teach the content in a conventional, lock-step course.

The third activity was to develop a computer program which incorporated the predictive model and estimated the cost of implementing and operating this particular, innovative training technique, i.e., conversion from conventional lock-step to self-paced, computer-based instruction.

RESULTS

A linear prediction model was developed to predict a student's time required to complete his first attempt on a given lesson. Fourteen predictor variables were selected, eleven descriptive of the instructional course content and three descrip-

tive of student characteristics. The final regression equation produced on $R = .63$ accounting for 39 percent of the variance in a student's first-attempt-lesson time. When the regression equation was validated on a second sample, the R^2 resulted in a loss of only 5.34 percentage points in accounting for the variance in the criterion variable, first-attempt-lesson time. The basic model was then modified to predict total course completion time.

A computer program, "Aid for Instructional Development and Evaluation (AIDE)," was written. It is a modification of Rand Corporation's MODCOM cost analysis program. It retains all of the cost-analysis features and outputs of MODCOM while allowing course completion time to be estimated by the regression equation developed in this study. Course completion times and cost estimates were generated for a standard sample and three additional samples in which student or course content characteristics were varied.

CONCLUSIONS

This study demonstrated that a viable model can be developed which predicts the costs and timesavings associated with individualization of an arbitrary training course through the use of a computer-based training system. The generality and precision of such a model is dependent on the breadth and accuracy of the data base from which the model is derived. Although the data base employed in this study was not as complete as could be desired, the resultant model was found to be reasonably accurate and is sufficiently general to be of value in the evaluation of courses for individualization. More importantly, a methodology has been developed and demonstrated which will become an even more useful tool as additional data are accumulated from computer-based training systems.

The results of exercising the AIDE program illustrated the impact of variations in course content on the timesavings to be expected from individualization. Current methods of instruction, methods employed in the course as it is taught in conventional, lock-step mode were found to be sensitive indicators of variations in course content and, hence, of expected timesavings. Thus, performance oriented training, for which the Plan of Instruction indicates a relatively high proportion of demonstration-performance activities, presents less promise for individualization than do courses containing a high proportion of cognitive and, particularly, memorization content.

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1.0 INTRODUCTION

1.1 BACKGROUND

A question of primary importance to those concerned with the design, development, implementation, or evaluation of innovations in training technology is one which addresses the cost and effectiveness of such innovations. Within the context of military training system development, interest has recently been focused on this question as it relates to innovations in the area of computer-based training (CBT). Here the concern has been one of not only attempting to find means for evaluating the actual benefits attributable to the innovation relative to its cost, but also to find a means for evaluating the expected benefits. That is, before large sums of money are invested in computer-based training innovations, it is important to know (a) whether the benefits and costs associated with the innovations can be quantitatively evaluated and (b) whether cost-effectiveness data to support implementation decisions can be predicted, given quantifiable information on training system parameters and their interactions with trainee and training material characteristics.

To address the preceding concern adequately, both descriptive and predictive models of a computer-based training system are required. Descriptive models serve the purpose of identifying the relevant parameters affecting cost and effectiveness decisions and of indicating the degree to which these parameters may be quantified. Predictive models serve the purpose of calculating expected outcomes, given information on the descriptive parameters and the relationships between them. A major problem, however, is that appropriate descriptive and predictive models have not been sufficiently integrated in an operational decision model which can be used in planning cost-effective implementations of CBT innovations.

The present study was undertaken to address this need. The specific goals and objectives of the effort are described in the following section, after which the types of problems involved in the development, integration, and validation of descriptive and predictive CBT models are discussed in a literature review.

1.2 GOALS AND OBJECTIVES

The goals of the present study were threefold: (1) to define and describe those computer-based training system parameters likely to affect cost-effectiveness decisions, i.e., to produce a descriptive model of a generalizable CBT system, including all relevant instructional, student, and training system variables; (2) to model, as accurately as possible, anticipated student performance in the generalized system described; and (3) to produce an operational computer model which will incorporate the predicted student and system performance data and can be used to calculate the expected costs and benefits of implementing selected CBT innovations.

To meet the preceding goals, the following objectives were specified:

- a. To describe the CBT characteristics expected to be related to measurable outcomes.
- b. To identify those outcomes that most reflect "benefits" attributable to innovations, e.g., student training time reduction and decreased elimination rates.
- c. To specify the relationships and interactions between all system parameters.
- d. To identify those parameters for which quantifiable data are available.
- e. To determine the type of modeling procedures most appropriate for the predictive model, e.g., appropriate statistical or mathematical models for predicting benefits and costs.
- f. To integrate the predictive model in a computer program that can be used as a planning aid.

The anticipated and actual problems related to these goals and objectives are discussed and summarized in the following section.

1.3 LITERATURE REVIEW

1.3.1 Selection of Criterion Variable - Only a few pertinent reports concerning the quantification of learning system features in terms of time-to-complete a unit of instruction, student performance, and training cost were identified. A seminal study reported by Wagner, Behringer, and Pattie (1973) addressed the description of training system features which predicted course completion time. Their study combined course-related instruments and standardized aptitude tests to predict time-to-complete. These devices included:

- o Tests of skills and knowledge necessary for the acquisition of certain military occupational specialties
- o Tests that sampled the content of the tasks to be learned during the course
- o Scales designed to measure motivational factors related to the subject matter of the course.

A step-wise multiple linear regression analysis was applied to the data. Correlations between the predictor variables and course completion time ranged from .65 to .87. These results supported the hypothesis that course-related predictors are better than measures of general aptitude in estimating the time-to-complete a course of instruction. In addition, the authors accepted the hypothesis that the relationship between course-related predictors and completion time variables is linear.

As an attempt to categorize and integrate the diverse variables influencing the instructional process, Carroll (1962, 1963) presented a conceptual model of school learning which has proven to be quite durable over the intervening fourteen years. The model output, the criterion variable, is degree of learning, i.e., performance on an achievement test after a fixed amount of elapsed time. The model itself consists of five elements, two pertaining to the characteristics of the instructional environment, and three to the characteristics of the student. The first instructional variable concerns the adequacy of presentation of the learning task, how clearly it is presented and explained, and how appropriately it is placed in the sequence of tasks to be learned. The second represents the opportunity for learning, the time allowed to learn the task. The first of the three individual difference variables represents the student's ability to understand the instruction. Carroll suggests this to be analogous to general or verbal intelligence and determines the extent to which the student is able to understand directions and explanations or to infer them from the content of instruction if they are missing. The second, aptitude, is defined as the time needed by the student to learn a particular task to criterion, given that the instruction is presented well enough for him to grasp it. Aptitude is considered to be a relatively invariant characteristic of the individual. The third element represents the maximum amount of time an individual will apply himself to a task. This is called perseverance.

A recent model of the instructional process proposed by Cooley and Lohnes (Glaser, 1976) deviates only slightly from Carroll's earlier formulation. Carroll's elements of aptitude and ability to understand instruction are replaced by a single variable, initial ability, representing the sum of the student's skills and intellectual capacities. Carroll's adequacy of presentation is replaced by two elements: (a) the extent to which the curriculum is structured, the methods of individualizing instruction, and the general organization of instruction; and (b) the quality of the student-teacher interaction. The term motivation has been substituted for perseverance, but it is defined as the student's tendency to engage in learning activities when the opportunity exists. Finally, the relationships among the elements are not stated as explicitly. Rather, these relationships are to be determined empirically through multivariate analysis.

Neither the Carroll nor the Cooley and Lohnes model, as stated, is appropriate to a self-paced, criterion-referenced instructional environment. In both, the criterion variable represents degree of learning, and opportunity for learning is assumed to be limited. In a criterion-referenced environment, degree of learning is, theoretically at least, controlled while opportunity for learning remains free to vary. Consequently, time per unit of instruction (time to criterion) or learning rate is the most appropriate criterion variable for a model of learning in a self-paced environment.

1.3.2 Selection of Predictor Variables - Psychologists and educators have long been aware that learning and performance on instructional tasks are a function of the student's level of ability or aptitude and his motivation. More recently, they have also recognized the importance of taking into account both situational and task factors. The search for those variables, however, and their associated measures which best describe the student's actual and expected performance remains a pervasive problem further complicated by:

- o The difficulty in obtaining quantitative measures of situational and task variables (Uprichard, 1975)
- o The fact that a student's trait levels of ability and motivation may not be as predictive of his performance as more situationally sensitive state measures (Speilberger, 1966; Spielberger, O'Neil, and Hansen, 1972)

- o The limited progress that has been made in the identification of satisfactory measures of student motivation (Bem and Allen, 1974).

Additional problems are raised when the concern is prediction of performance in a self-paced, individualized, criterion-referenced instructional environment. A majority of research on variables related to learning has been conducted in group-paced, conventional instructional environments, (Campbell and Schwen, 1971; Schwen, 1973), and existing theories and data on ability and motivational variables have focused on achievement scores rather than learning rates as the dependent variable of interest (Brown and James, 1972; Colton, 1974; McAvoy, Kalin, and Franklin, 1973).

1.3.2.1 Student Ability/Aptitude - A common approach to the problem of identifying student characteristics related to performance in a complex instructional system is some form of task analysis. Campbell and Schwen (1971) argue for an analysis of learning tasks in terms of the effects they have on the student's cognitive processes and personality variables. They stress that possible interactions between task and learner characteristics be considered. Schwen (1973) suggests that a model most appropriate for analysis of learner characteristics is one that combines empirical methods, e.g., predictive statistical models, with task analysis. The important point is that such analytical methods can be used to identify potentially important variables or interactive relationships between variables that should be considered in a student ability/aptitude parameter.

1.3.2.2 Situational/Task Variables - In considering relevant situational/task variables, it is instructive to distinguish between those variables which may vary between students, such as type of instructional treatments, and those which are constant for an individual student but vary across tasks, e.g., criterion levels or task difficulty. Just as analyses of learning tasks and learner characteristics were recommended for the identification of an ability/aptitude parameter, it is an equally appropriate approach to the identification of relevant situational/task variables (Campbell and Schwen, 1971; Schwen, 1973). Walberg (1975) has stressed the need for analyses which identify other possible variables predictive of student performance. He bases this on the fact that, although aptitudes or abilities can be reliably measured, they can usually account

for no more than half the variance in student performance. Uprichard (1975) suggests that organizational structure or classroom variables be taken into account as well as evaluation variables, e.g., criterion levels and frequency of tests.

Some additional situational/task variables which may be important in a self-paced instructional environment are suggested by the Wagner et al (1974) study. Among their findings were:

- o Total time could not be predicted as well as instructional time due to many unknown factors related to variabilities in testing time
- o Grouping of data by instructional mode was required in order to predict completion times more accurately.

These findings suggest that potentially important situational/task variables would include ratios of instructional time to testing time, relative difficulty level of each instructional unit of interest, testing frequency, ratio of audio-visual to printed materials, and the frequency with which an adaptive model choice (if present in the system) constitutes the actual assignment.

2.0 OVERVIEW OF THE TECHNICAL APPROACH

The work described herein consists of three major activities:

- a) Definition of a descriptive model of a generalized, computer-based training system.
- b) Generation of a predictive model of student performance in a computer-based training environment.
- c) Development of a computer program incorporating the predictive performance model to estimate the cost of such a system.

The primary purpose of the descriptive model was to identify the component activities involved in the instructional process in a computer-based training environment. Further, the model served to identify: (a) subject matter characteristics; (b) instructional and system design considerations; (c) student individual difference characteristics; and (d) the relationship of these variables to the various components of the model. The variables to be considered by the predictive model served to define the domain of computer-based training systems to be addressed by the predictive model. As defined, the model assumed a criterion referenced testing environment and emphasized, as the dependent variable, the time to reach criterion on an arbitrary unit of instruction.

Since this study focused on the prediction of student time-to-completion of a unit of instruction (so as to demonstrate time-savings and cost-effectiveness), a model to account for prediction of time was developed. The analysis of data within this model necessitated the use of a statistical technique through which one can analyze the relationship between the criterion or dependent variable and a set of predictor or independent variables.

The statistical technique chosen for this effort was multiple regression. This statistical treatment is useful primarily because of its ability to produce linear prediction equations (Kerlinger and Pedhazzer, 1973) as well as computing statistics that provide the researchers with statistical inference procedures for determining confidence limits for estimates with a means for measurement of variance in the dependent variable accounted for by the predictor set. Finally,

the use of multiple regression provided the authors with a degree of control over extraneous variables in order that the combined contribution of a specific set of variables could be more closely examined.

Specifically, the intent was to develop a model in the form of a regression equation in which the criterion was time-to-complete an arbitrary instructional unit. Predictor variables were drawn from the several categories defined by the descriptive model and were limited to the type of information which will be available to or can easily be obtained by a military training course developer. The actual predictor variable data were sampled from course planning documents for two courses which had been group-paced but are currently being conducted in a self-paced mode under the control of a computer-based training system - - the Advanced Instructional System (AIS) at Lowry Air Force Base, Colorado.

The predictor variables fell into four broad categories. The first concerned course content, information which was either available directly from the course planning documents or which could be derived from these documents. The second category consisted of instructional design considerations. Variables in this category were broadly defined and limited by the consideration of only those which varied between or within the two AIS courses. The third consisted of test characteristics, the performance standards established for the two courses. The fourth category of predictor variables consisted of student individual difference measures. Two classes of such measures were considered: those which would normally be available to the developers of a military training course; and an additional set of measures which was available to this study because of its use in the AIS pre-assessment battery.

The criterion variable explicitly predicted by the regression equation is first-attempt-time on an AIS lesson. The model was then expanded to address the time required to complete a larger instructional unit consisting of n lessons and an end-of-unit criterion test. Lesson and unit level criterion data were drawn from the AIS student performance data bases for the Inventory Management and Weapons Mechanic courses.

The most relevant predictors in each of the four categories of predictor variables were determined through a series of linear model comparisons. In such

comparisons, two equations, one including and the other excluding the variable(s) of interest within variable categories, are evaluated in terms of the reduction in the square of the multiple R from the first to the second linear model. In the comparisons made, primary emphasis was placed on the cost of obtaining data for the variable(s) being considered for exclusion relative to its (their) predictive value. Following reduction to a parsimonious set of predictors, stepwise multiple linear regression was used to obtain a final predictive model. This final model was then cross-validated and tested for generality as an additional evaluation of validity across courses.

The final activity in the study was the production of a computer cost analysis program entitled Aid for Instructional Development and Evaluation (AIDE). AIDE is a modification of the Rand cost analysis program MODCOM, Method of Designing Instructional Alternatives (MODIA) (Hess and Kantor, 1976) set of programs. The modification consisted of reprogramming MODCOM to use the predictive model regression equation developed in this study while retaining all of MODCOM's cost analysis features. The program output is a series of tables which describe the course specifications including the student and lesson variable values employed by the predictive model regression equation, resource requirements and costs, and the total course cost. To illustrate its use, the AIDE program was exercised in answering three sample questions related to student characteristics and course design (See Section 5.4).

3.0 DESCRIPTIVE MODEL OF COMPUTER-BASED TRAINING SYSTEMS

Antecedent to the development of the computer-based predictive model, it was necessary to define the scope of the instructional process to be modeled. This was done through the generation of a descriptive model. This descriptive model provided a basis for (a) conceptualizing the overall instructional process, (b) identifying gaps in the conceptualization, (c) identifying variables which could be quantified for inclusion in the predictive model, (d) determining data collection requirements, and (e) assisting in the interpretation of results. What is presented is not intended to represent the only way or the optimal method of accomplishing individualized, self-paced instruction, but rather it is an attempt to represent a generalized model which can encompass a wide variety of computer-based training systems. The descriptive model was developed in two stages. The first stage, essentially the context for the descriptive model itself, is illustrated in Figure 1.

The most basic element defining the characteristics of an instructional process model would appear to be the criterion behaviors to which the student is to be trained - the set of skills assumed to be required in the field. In the Air Force, these skills are rather explicitly defined by the Specialty Training Standard (STS) for each field.

The curriculum, the instructional content of a particular course, represents the interpretation of these behavioral goals by the course personnel. Since the curriculum is defined by the course personnel, it must be assumed that it will be shaped by their cumulative experience, both in the field and in the classroom, and by their knowledge of local institutional constraints, e.g., availability of training devices, usual ratio of instructional personnel to students, and physical plant limitations. The final definition of the curriculum is represented by the course planning documents. For the Air Force, this is the Plan of Instruction (POI). These documents contain an explicit statement of the course content, the amount of instruction (time) to be devoted to each topic, the instructional method (e.g., lecture or demonstration) where available, and the training aids (e.g., films, manuals and actual equipment to be employed). Throughout this study, it

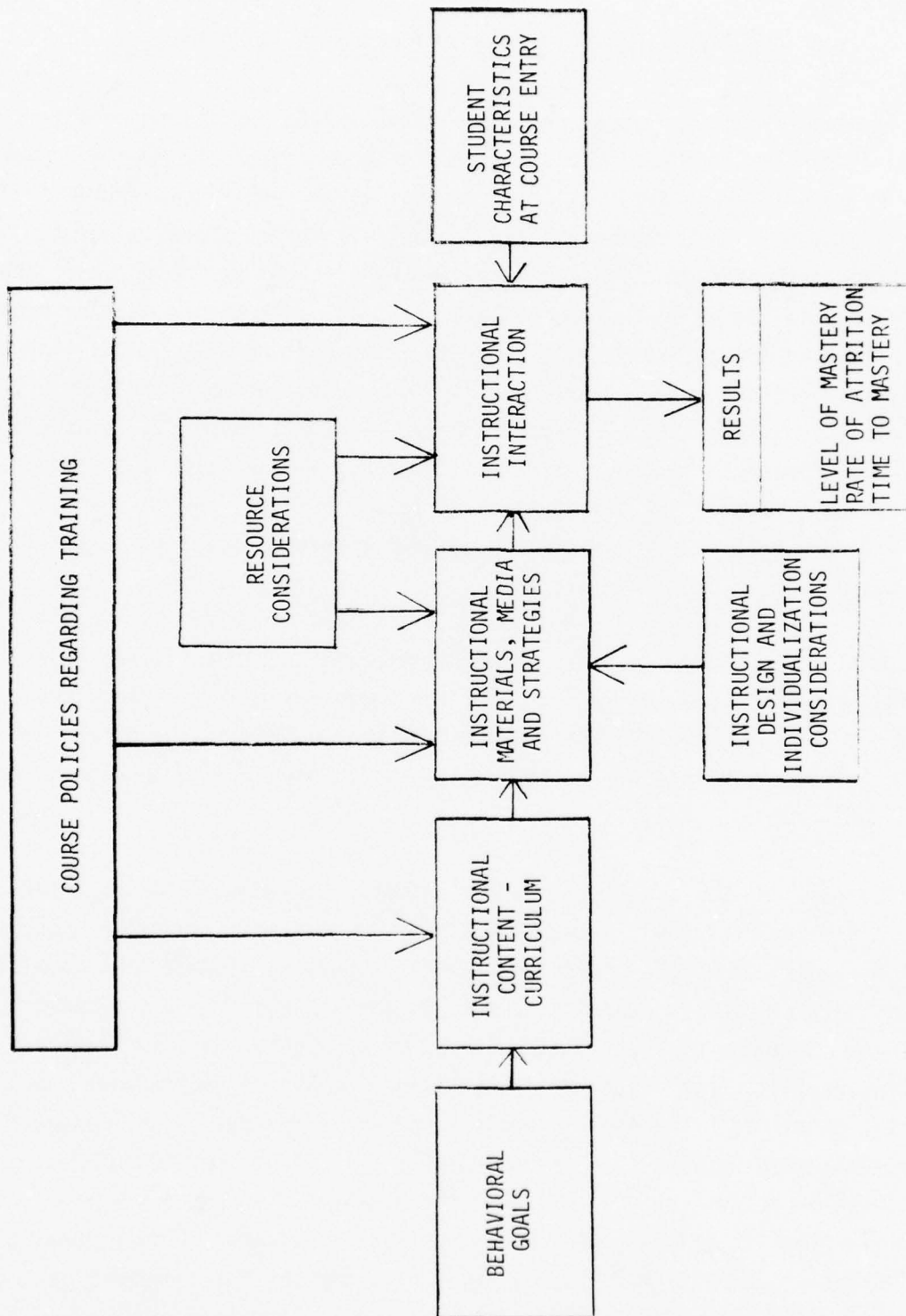


FIGURE 1: General Model of Instructional System Development, Implementation and Evaluation

will be assumed that the course to be modeled is in existence, probably in a conventional, group-paced format, and that course planning documents are available.

Since the purpose of the predictive model being developed is to represent a self-paced, individualized course, it is assumed that in situations in which the model is to be employed, a complete set of instructional materials, representing the entire course content, will need to be selected or developed. Thus, the next block in the diagram represents the means by which the instructional content is to be presented. These are the defining characteristics of the course of instruction to be developed. Is the instructional method to be expository or oriented toward discovery and problem solving? Is the presentation narrative or programmed, that is, frame oriented with embedded questions? If programmed, what is the frequency of interaction? To what extent are pre- and post-organizers, such as objectives and post-questions employed? Is the instruction merely self-paced, or is it individualized in the sense of advanced placement and assignment of alternative instructional treatments? What presentation media are employed, e.g., print, audio-visual, or computer-assisted instruction? As is indicated by Figure 1, these instructional characteristics are a function of several considerations: the content to be taught; explicit decisions regarding instructional design, individualization strategies, and media; the availability of instructional resources; and the influence of institutional constraints and policies. The category of instructional resources is meant to include presentation media (printed materials, audio-visual devices, terminals for computer-assisted instruction), the materials and equipment which the student is being trained to work with in the field (e.g., manuals, actual devices and tools, simulators), and terminals for interacting with a computer-management system.

The instructional interaction, the process through which learning takes place, is primarily a function of the instructional content, mode of presentation, and the characteristics of the students at the time of their entry into the course - the level of their aptitudes and abilities. Although not shown explicitly in Figure 1, student characteristics will, hopefully, have been taken into consideration by the instructional design process and, to the extent necessary, reflected in the course planning documents. It is unreasonable to expect, however, that the instructional presentation will be perfectly matched to student characteristics. There

is also the possibility that the average ability level of the students will vary over time as a function of demand for trained personnel and economic fluctuations in the civilian sector. Finally, the total distribution of student characteristics, as well as the average level, must be considered in evaluating the entire training system throughout.

It must be recognized that the nature of the instructional interaction is also shaped by existing course policies. These are, unfortunately, intangible factors concerning the prevailing attitudes among the instructors and their supervisors, and the incentives, positive and negative, explicit and implicit, to which the students are exposed. Finally, the instructional interaction, particularly the time it requires, is directly a function of the actual, day-to-day availability of the instructional and management resources. While resource availability was presumably taken into consideration by the instructional system design, problems may arise if the student entry rate is substantially increased or if equipment maintenance is not adequate. In that case, student queuing for resources can account for a substantial portion of the total training time.

There is undoubtedly a host of measures by which the effectiveness of the instructional interaction, of the total instructional system, can be judged. The most tangible measures, however, are level of mastery, rate of attrition, and time-to-criterion. As will be discussed in subsequent sections of this report, level of mastery is exceedingly difficult to capture in a model intended to generalize across training programs. Since the prime purpose of the predictive model is to provide a tool for the comparison of alternative instructional systems, all of which are criterion referenced, it will be assumed that the required level of mastery is primarily a policy decision that remains constant from one system to another. If level of mastery is indeed fixed, the only two parameters left free to vary are rate of attrition and time-to-criterion. While attrition would appear to be a plausible dependent variable, it has been the authors' experience that, in a military training environment at least, it is also largely a function of course policy. Thus, the primary dependent variable to be considered by the model will be time-to-criterion, the time required to complete the course of instruction.

Given the dependent variable of time-to-completion, the next step was to develop a description of the instructional interaction process which would

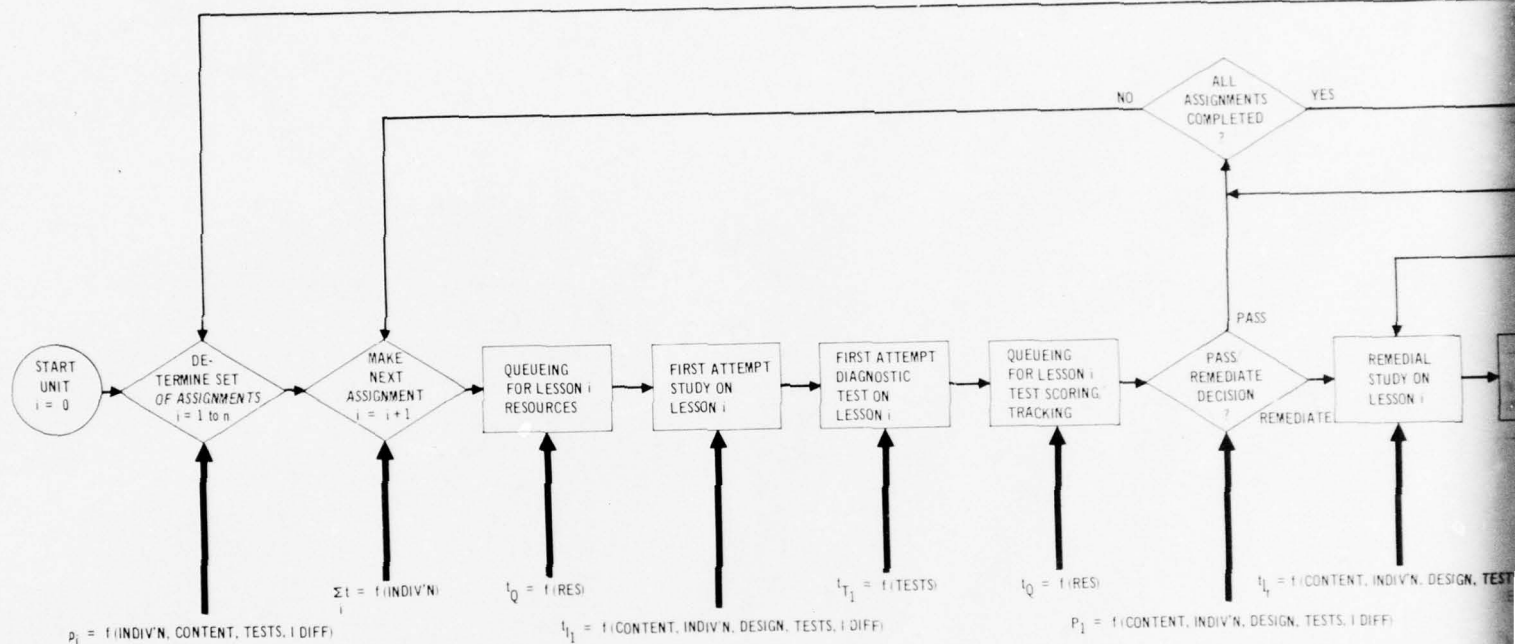
(a) account for time-to-completion, (b) generalize across a variety of computer-based training systems, and (c) incorporate the classes of independent variables outlined in Figure 1 and the preceding paragraphs. Finally, it was desirable that the model be sufficiently fine grained that each of the individual components of the model could be related to a small subset of the independent variables and that the times attributable to each component sum to equal total time-to-complete the instructional unit. This descriptive model is shown in Figure 2.

A course structure is assumed in which the curriculum consists of one or more major instructional units. Each unit is assumed to end with a criterion referenced examination which the student must pass in order to proceed to the next unit, or, in the case of the last unit, to be graduated from the course. In the descriptive model, this examination has been termed a credentialling test. In Air Force technical training, the corresponding instructional unit is a "Block." Student scores on end-of-block tests are entered in the student's permanent record; a student who meets criterion on the block test is considered to have demonstrated proficiency on the block content, and decisions concerning academic elimination from the course are made on the basis of block test scores and times-to-block-completion. It is assumed that, up to a point, a student failing to pass the credentialling test will be reassigned part or all of the instructional unit and then retested. The descriptive model is intended to account for the time required for a student to complete an arbitrary instructional unit - to reach criterion on the unit credentialling test.

Within each major instructional unit, it is assumed that the curriculum is divided into a number of smaller units, each covering one or more objectives, which will be termed lessons. It is further assumed that, in general, each lesson has a criterion referenced test over the lesson content. Lesson tests are intended to be for diagnostic rather than credentialling purposes. That is, the primary purpose of the diagnostic tests is to track student's progress through the course, to detect specific areas of weakness and misunderstanding, and to provide a basis for lesson level remediation in these areas. Diagnostic test scores would not, as a rule, be made part of the student's permanent record.

Turning now to the components of the model, the first decision point, Determine Set of Assignments, represents a form of individualization which, in

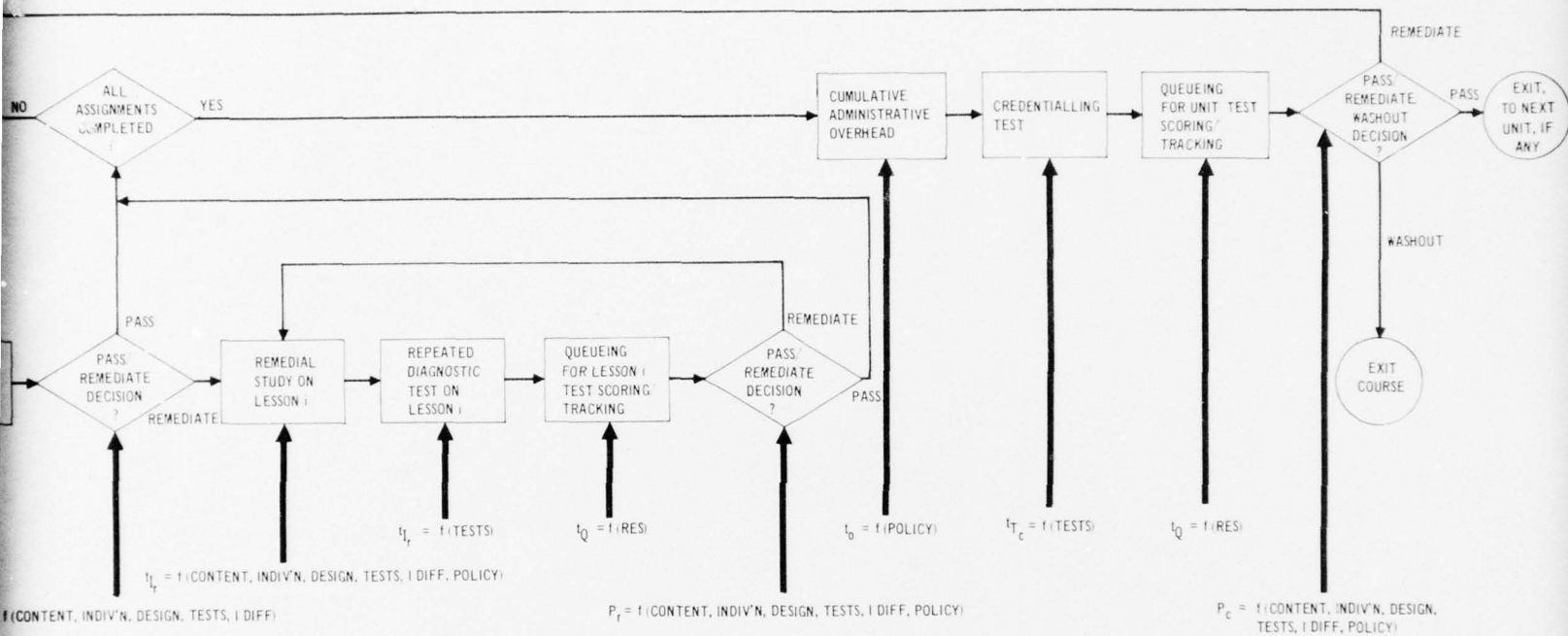
FIGURE 2: DESCRIPTIVE MODEL OF TIME TO COMPLETE AN INSTRUCTIONAL UNIT UNDER



CATEGORIES OF INDEPENDENT V

CONTENT	- INSTRUCTIONAL CONTENT QUANTITATIVE MEASURES QUALITATIVE MEASURES CRITERION BEHAVIORS CONTENT CLASSIFICATIONS	I DIFF
INDIV'N	- INDIVIDUALIZATION CONSIDERATIONS PLACEMENT ALTERNATIVE INSTRUCTIONAL TREATMENTS	RES
DESIGN	- INSTRUCTIONAL DESIGN CONSIDERATIONS MEDIA ORGANIZERS	POLICY
TESTS	- TEST CHARACTERISTICS TYPE OF TEST ITEMS NUMBER OF ITEMS CRITERION LEVEL	

TO COMPLETE AN INSTRUCTIONAL UNIT UNDER COMPUTER-BASED TRAINING SYSTEM MANAGEMENT



CATEGORIES OF INDEPENDENT VARIABLES

INSTRUCTIONAL CONTENT	I DIFF	- STUDENT INDIVIDUAL DIFFERENCE CHARACTERISTICS
QUANTITATIVE MEASURES		APTITUDES
QUALITATIVE MEASURES		INTELLECTUAL SKILLS
CRITERION BEHAVIORS		PSYCHOMOTOR SKILLS
CONTENT CLASSIFICATIONS		AFFECTIVE TRAITS
INDIVIDUALIZATION CONSIDERATIONS	RES	- RESOURCE CONSIDERATIONS
PLACEMENT		NUMBER OF TERMINALS
ALTERNATIVE INSTRUCTIONAL TREATMENTS		NUMBER OF INSTRUCTIONAL RESOURCES
		RESOURCE MANAGEMENT
INSTRUCTIONAL DESIGN CONSIDERATIONS	POLICY	- COURSE POLICY CONSIDERATIONS
MEDIA		
ORGANIZERS		
TEST CHARACTERISTICS		
TYPE OF TEST ITEMS		
NUMBER OF ITEMS		
CRITERION LEVEL		

any particular system, may be absent or present and, if present, may be present in varying degrees. It serves two functions. On a student's first pass through the instructional unit, it is analogous to advanced placement - on the basis of known information about the student's abilities and current skills, is it probable that he could skip one or more lessons without seriously jeopardizing his chances of meeting criterion on the credentialling test? Similarly, on a remedial pass through the unit (following failure to meet criterion on the credentialling test), what minimal set of lessons (or partial lessons) can be assigned and still have reasonable assurance that the student will meet the credentialling test criterion on a retest? Within the descriptive model, this component is represented by the probability (p_i) that the student will be assigned a given lesson (lesson i). It is assumed to be a function of the system's capability for individualization, the content of lesson i , the characteristics of the credentialling test, and the student's specific abilities and skills.

The second decision point, Make Next Assignment, is similar in that it also represents a form of individualization which may be absent or present in varying degrees in different instructional systems. It is intended to represent system capability for individualized assignment of alternative instructional treatments at the lesson level. Time savings attributable to this component are represented as being distributed across other components in the model. That is, individualized assignment of alternative treatments will impact both first attempt and remedial study times, the probability of passing the diagnostic tests, and, to an extent, the time required for testing itself.

The next component, Queuing for Lesson i Resources, is the first to represent a time consuming activity, any delay due to the unavailability of lesson resources which the student may encounter prior to being able to start his next assignment. It has lower limit of zero time and is assumed to be a function of both the quantity of available resources of the needed type and the system's capability for resource management, for scheduling assignments so as to avoid resource bottlenecks.

The component entitled First Attempt Study on Lesson i represents the amount of time consumed by the student's initial study of the lesson i content on a given

pass through the instructional unit, either his first pass through the unit or unit level remediation. This component accounts for the major portion of the student's first pass time in the instructional unit and is assumed to be a function of the lesson content, system capability for individualization (the availability and individualized assignment of alternative instructional treatments), instructional design and presentation considerations, the known (to the student) characteristics of the lesson i diagnostic test, and the characteristics of the student himself.

3.1 FIRST ATTEMPT DIAGNOSTIC TEST TIME.

The amount of time which the student spends completing the test following lesson i, has a lower limit of zero (representing the case in which there is no lesson i diagnostic test) and is assumed to be a function of the test characteristics. These characteristics include whether the content to be tested is primarily knowledge or involves the demonstration of performance skills, and if written, the type of items (completion, multiple choice, or true-false), the number of items (or number of steps in a performance task), and the criterion level. While it could be argued that the amount of time the student spends on the test is also a function of his level of knowledge, and hence a function of the same factors that influence study time, the simplifying assumption is made, for the sake of parsimony, that these factors make a relatively small contribution to the total variance in testing time. They are taken into consideration in a subsequent component representing the probability that the student will meet criterion on the diagnostic test.

3.2 QUEUING TIME FOR LESSON TEST SCORING/TRACKING.

This represents the amount of time the student must spend, following completion of his diagnostic test, until his test has been scored and he has received his next assignment. Placing this component after the diagnostic test time component implies that testing itself is done off-line. The position of the two components would simply be reversed to represent an on-line testing situation. It is assumed to be a function of the number of terminals available for student/system interaction, the speed with which these interactions can take place, and the extent to which assignment scheduling (resource management) can prevent the occurrence of waves in the level of student demand for terminals.

3.3 PASS/REMEDiate DECISION

The following decision point represents the outcome of scoring the diagnostic test, the probability that the student has met the test's stated criterion. If so, it is assumed that he proceeds to his next lesson assignment, if any. If not, it is assumed that he is assigned a remedial activity designed to enable him to meet criterion on the previously failed objectives. This probability is assumed to be a function of the content of lesson i, the system's capability for individualized assignment of alternative instructional treatments, instructional design considerations for lesson i, the characteristics of the lesson i diagnostic test, and the relevant characteristics of the student himself. If there is no diagnostic test corresponding to lesson i, the decision would, of course, always be "Pass."

Let us first consider the case in which the student fails to meet criterion on the diagnostic test and is assigned a remedial activity. The bulk of this activity is represented by the component labeled Remedial Study on Lesson i. The amount of time required for this activity is assumed to be a function of the same factors which determined first attempt study time on the lesson and, in addition, course training policy considerations. The intent of including this policy factor is to allow for situations in which the local training policy dictates that the student retest within a certain period of time or that the student spend at least a minimum period of time before retesting.

It will be noted that the component Queuing for Lesson i Resources has not been included in the remedial loop. It is assumed that resource management will be such that if a training device was required for the student's first attempt on the lesson, the device will remain available to him for remediation.

3.4 REPEATED DIAGNOSTIC TEST ON LESSON i AND QUEUING FOR LESSON TEST SCORING/ TRACKING

The next two components, are essentially the same, and a function of the same factors, as the comparable components in the loop representing initial study. It should be noted that the number of items on the diagnostic test, and hence the time required for testing, could change if a scheme is employed by which a student is retested only over previously failed objectives.

The following decision point, the probability that the student will now meet criterion, is analogous to the prior, first pass decision point and is assumed to be a function of the same factors with the addition of a course policy variable. The introduction of the policy factor is to allow for those situations in which local policy might require that a student proceed to the next lesson assignment after two or three lesson attempts. This might be accomplished, for example, through intensive remediation by an instructor and his certification that the student has met the diagnostic test criterion. If the decision is that the student again failed to meet criterion, it is assumed that he will recycle through the remedial loop. A decision that the student has now met criterion returns him to the same point as was the case for a student who met criterion following his initial attempt on lesson i.

3.5 INSTRUCTIONAL UNIT LEVEL COMPONENTS

If the set of lessons assigned to this student for the current instructional unit has not yet been completed (All Assignments Completed?), he repeats the cycle described in the preceding paragraphs. If all assigned lessons have been completed, that is, if the student has studied all assigned content in the instructional unit, he is assigned the unit credentialling test.

The component shown preceding the credentialling test, Cumulative Administrative Overhead, is intended to account for that time which, while the student was in the current instructional unit, was spent on non-instructional activities. Examples would be roll call, extra group instruction such as safety lectures, classroom clean up, assignment to special details, smoking and coffee breaks. This time is to be strictly a function of local course policy and would have to be estimated in each specific situation.

Time spent completing the credentialling test is assumed to be a function of the same test characteristics as was the case for the diagnostic tests. This component would, however, also include any time spent in critiquing the student's item-by-item performance on the credentialling test, an activity assumed to be unlikely following the more frequent diagnostic tests.

Again, allowance must be made for the time required to complete test scoring. This is represented by the component labeled Queuing for Unit Test Scoring/Tracking and, as was the case for diagnostic test queuing, is assumed to be a function of terminal resource availability.

3.6 PASS/REMEDiate/WASHOUT DECISION

The final decision point represents the outcome of the evaluation of the student's performance on the credentialling test. If the student is determined to have met the stated criteria, he proceeds to the next instructional unit or is considered to have completed the course. It is assumed that a student who fails to meet criterion will be "washed back" to repeat some or all of the lessons in the instructional unit. For the sake of parsimony, it is assumed that this major, unit-wide remediation can be modeled in the same manner as was the student's first pass through the unit. The amount of material assigned for remediation may differ from the student's first pass through the unit depending on the system's capability for individualization. Finally, it is assumed that the decision to eliminate a student from the course on the basis of academic deficiencies will only be made following a credentialling test.

4.0 PREDICTIVE MODEL OF COMPUTER-BASED TRAINING SYSTEMS

4.1 DESCRIPTION OF DATA SOURCE

4.1.1 Selection Criteria - The criteria established for selecting a data source were as follows:

- o A computer-based, self-paced, individualized instructional system well into its development cycle
- o The availability of quantitative and qualitative course content descriptions from both the prior, conventional mode of instruction and from the current self-paced mode
- o The availability of pre-instructional measures of trainee characteristics
- o The availability of trainee performance (time and score) data under the computer-based system.

Of the available sources, the Air Force Advanced Instructional System (AIS) at Lowry Air Force Base, Colorado, was considered the best to meet these criteria. In addition, resident specialists, familiar with the characteristics and use of the AIS data base were available as consultants. Computer time and a limited amount of software support were also made available.

4.1.2 The Advanced Instructional System - AIS is being developed by the McDonnell-Douglas Corporation under a contract with the Air Force Human Resources Laboratory (TT), Lowry Air Force Base (Rockway and Yasutake, 1974; Yasutake and Stobie, 1975). It is intended to be a comprehensive CMI/CAI system for the administration and management of large scale, individualized technical training. At the time of this study, four courses, containing approximately 600 students, were being supported with the overall goal of achieving an average 25 percent reduction in training time over what was required prior to system implementation. These four courses represent a wide range of learning requirements, from clerical to mechanical to problem solving skills, and cover a variety of course administrative requirements. In addition, AIS serves as a research and development tool to allow evaluation of a variety of innovations in instructional technology, particularly those aimed at the adaption of instruction to student individual differences.

A large, central computer (CDC Cyber 73-16) provides data processing capability. Data input and output are supported by two types of terminals. A

management terminal (consisting of a form reader, printer, and minicomputer enclosed in a console) is used to read and score test forms, transmit data to the central computer, and print out student prescriptions and management reports. An interactive terminal (consisting of a plasma display and keyboard) is used for instructor and course author interaction with AIS data files and will also be used for on-line, adaptive testing and CAI.

The system was designed to provide the functions of diagnosis of student performance, forward-going assignment prescriptions, resource allocation and scheduling, guidance and counseling, information retrieval, report generation, and support for evaluation and research. The software to support these functions comprises the Adaptive Model and Applications Programs component of the AIS. This software was tested and implemented in all four courses during the summer of 1976.

The Adaptive Model contains the component entitled Adapter which assesses cognitive and affective student traits and states, and selects instructional alternatives that best match the needs of each student at each node of the instructional sequence. The individualization afforded by the Adapter is constrained by the prerequisite relationships inherent in a course structure and by the availability of instructional resources. Thus, a Resource Allocation/Scheduling Model within the adaptive model maintains the inventory of available resources, restricts the assignment of alternatives to the available resources, supports the scheduling of team tasks, and attempts to optimize the utilization of expensive and limited training resources.

Both the Adapter Model and Resource Allocation/Scheduling Model operate on predictions as to the amount of time each student will require to complete his current assignment and his current course unit. These data, in conjunction with predictions of student scores on each criterion test, are used to provide the guidance and counseling function in that each student's performance is continually evaluated relative to other students.

At the time this study was being conducted, the AIS was operating in a more rudimentary mode, termed Initial CMI. Although the courses were self-paced, the primary means of instruction was limited to programmed textbooks. Instructional alternatives were under development, but only a very few had been integrated into

the courses. While the main track of instruction did include some instances of audio-visual lessons, the number and variety of these lessons were insufficient for the purposes of this study. While the system provided test scoring and data recording capabilities, the sequence in which the lessons were studied and the assignment of instructional resources were under the control of the classroom instructors. Each student recorded the amount of time he spent in various activities, e.g., first-attempt-lesson-study, remedial study, and testing, on his individual test answer sheets. These data were recorded by the system, but there was no direct measurement of these times.

4.1.3 Courses Selected - The four courses supported by AIS at the time of the study were Inventory Management Specialist, Materiel Facilities Specialist, Precision Measuring Equipment Specialist, and Weapons Mechanic. The analysis to be conducted required a large data base (hence a relatively large student flow) and a large overlap between the content of the current, self-paced course and the earlier, conventional course. On the basis of these considerations, the two courses selected for modeling were Inventory Management Specialist (IM) and Weapons Mechanic (WM).

Under conventional instruction, IM was a 210 hour course leading to the Air Force Specialty of Inventory Clerk. Course content primarily concerns inventory procedures, record keeping, and shipping. The work requires clerical and procedure-following skills. The selection criterion for admission is a percentile score of 60 on either the General or Administrative Scale of the Armed Services Vocational Aptitude Battery (ASVAB) given all enlisted personnel at the time of induction.

Under conventional instruction, WM was a 540 hour course leading to a specialty in weapons handling. The course teaches the cognitive and psychomotor skills required to handle and load air-to-air and air-to-ground weapons and to troubleshoot and repair related equipment. A key feature of the WM course is its employment of team concepts in skill development. The admission criterion is a percentile score of at least 60 on either the Electrical or Mechanical scales of the ASVAB.

Both courses were divided into a number of "blocks" (six in IM; 12 in WM), each approximately a week in length. Each block contained from 10 to 30 lessons and

an end-of-block test. Students were required to meet criterion on these block tests before proceeding to the next block. Under AIS, lessons are approximately one to two hours in length; each covers two or more instructional objectives, and most conclude with a diagnostic lesson test. Under conventional instruction, the lessons had tended to be longer, and, as a rule, a conventional lesson was broken up into two or more AIS lessons.

Of the six blocks in the IM course, the first five were analyzed for this study. Insufficient student performance data were available from the sixth since it had recently undergone a major revision. The last four of 12 blocks were analyzed in the WM course. The course was being implemented under AIS from back to front, and insufficient data were available from the lower numbered blocks.

4.2 DEFINITION OF VARIABLES FOR ANALYSIS AND DATA COLLECTION PROCEDURES

4.2.1 Definition of Criterion Variable - Several types of time data available from AIS were considered for use as the criterion variable to be predicted by the model. These included block completion time, first pass block time, lesson completion time, first attempt lesson time, first attempt study time, and first attempt test time. Of all of these time criteria, block completion time was considered to be the most useful criterion and, because of its relationship to the descriptive model, the most appropriate. It was, therefore, selected as the criterion variable to be predicted by the model.

For purposes of developing the predictive model, however, the number of blocks was too small to provide sufficient variability in content. Time prediction equations needed to be developed at the lesson level. As was noted in the discussion of the descriptive model, it could not be assumed that the sum of lesson completion times would equal block completion time or even first-pass block time. Each pass through the block also includes the time required for the block test itself, cumulative administrative overhead which included student "breaks," and time lost due to queuing for resources and test scoring. No accurate time data were available for any of these components. The most appropriate approach, therefore, appeared to be one in which the variable predicted would be lesson completion time. A proportional "lost time" estimate, determined from the discrepancy between the sum of lesson completion times and block completion time,

and assumed to contain the time allocated to block remediation, overhead, and queuing would then be employed to provide an estimate of block completion time.

It was found, however, that lesson completion time was itself extremely unreliable. The time required for each attempt on the lesson was recorded on a separate test answer sheet with an identifying attempt number. Because of the multiple pieces of paper involved and because procedures were not always rigidly adhered to in the classrooms, the problems of incomplete and missing data were widespread. The amount of available lesson completion time data which could be considered reliable was inadequate for the modeling study.

Some consideration was given to the separate prediction of reported first-attempt-study and first-attempt-test time. This approach was discarded, however, since there had been a continual problem in instructing students in how to differentially record study time and test time due to confusion over self-tests which were to be counted as part of study time. The variable finally selected to serve as the criterion to be predicted was first-attempt-lesson-time. This variable was based on a simple start and stop time recorded on the student's answer sheet and had been found to be the most reliable of the various time measures. For the majority of cases, it was equivalent to lesson completion time. It could be related to block time by increasing the magnitude of the proportion of "lost time." Viewed in the context of the Descriptive Model (Figure 2), the criterion measure was the cumulative time (across lessons) attributable to the two components entitled First Attempt Study on Lesson i and First Attempt Diagnostic Test on Lesson i.

The prediction of block and lesson test scores presented a very different problem - that of generalizability. It was intended that the predictive model to be developed should generalize across a variety of technical training courses. While there is no ambiguity concerning the meaning of a clock hour and no variation in the meaning of this concept from one course to another, this is not the case with regard to test scores. The probability that a given student will obtain a passing score on an arbitrary test is at least as much a function of test item difficulty as of the student's characteristics and the content being tested. Item difficulty is, in turn, primarily a function of the experience and opinions

of the developers of the specific instructional materials and the test. It is a safe assumption that the foremost factor influencing a test developer's decisions regarding item difficulty and adequate criterion performance is his past experience with the performance of students in this particular course of instruction. Thus, while it appeared implausible to generalize across courses with respect to expected test score or expected failure rates, it did appear reasonable to expect that the level of student performance would remain relatively constant from conventional to self-paced, individualized instruction. This assumption was made explicit in the predictive model being developed. That is, it was assumed that the level of within-course student performance, the skill level of the course graduates, and the rate of attrition would remain unchanged following the transition from conventional to self-paced, individualized instruction. The only dimension left free to vary was, therefore, time.

4.2.2 Definition of Predictor Variables - The variables selected for investigation as potential predictors of first-attempt-lesson time will be discussed in terms of the categories of independent variables influencing the instructional interaction which were outlined in Figure 2 and discussed in Section 3.0.

While it would have been plausible to consider behavioral goals (see Figure 1) as a category of predictor variables, it was considered more appropriate to obtain measures of the instructional content itself, the course curriculum. Information regarding both classes of factors were available - the Specialty Training Standard (STS) reflecting goals and the Plan of Instruction (POI) reflecting content. While the information provided by the STS is more basic and less subject to change, the relationship between the two documents should remain constant unless the course goals and content are subjected to the type of re-analysis called for by an Instructional System Development (ISD) exercise (U.S. Army Training and Doctrine Command, 1975). The purpose of the predictive model is to examine the effects of self-pacing and individualization, not the effects of ISD. It was therefore assumed that content, as reflected in the POI, would remain constant during the transition from conventional to individualized instruction. Use of the POI as the reference document for course content has the further advantage of reflecting the influence of local training policy. The specific information derived from the POI is described in paragraph 4.2.2.1.

As we discussed in paragraph 4.1.2, the Initial CMI mode of operation, which was in effect at the time of this study, did not include computer controlled individualization of the type required by the descriptive model, i.e., advanced placement and assignment of alternative instructional treatments. Therefore, no variables pertaining to this factor could be included in the predictor set.

In the category of instructional design considerations, it was not feasible to include alternative media characteristics as predictors because of the limited number of lessons employing media other than text. The extent to which advance, embedded, and post-instructional organizers were present in various lessons did provide a basis for defining a number of predictors. These are discussed in paragraph 4.2.2.2. Predictors in the test characteristics category are discussed in paragraph 4.2.2.3. In addition, a variety of measures of pre-instruction, individual student difference characteristics was investigated. These are described in paragraph 4.2.2.4.

While the quantity and quality of instructional and management system resources have a definite effect on the characteristics of the instructional interaction, particularly the time required for its completion, there was not sufficient variability in this factor among the various AIS courses to permit its use as a predictor variable. Consequently, the predictive model assumes an "adequate" supply of resources.

It was recognized that course policy regarding training has a pervasive influence on the instructional interaction. It is by nature, however, course-specific and relatively intangible. For this initial attempt at model development, therefore, it was considered necessary to ignore this factor - to consider its effect as contributing to unaccounted for variability except in-so-far as course policy influences were reflected in the instructional content.

4.2.2.1 Course Content Variables - Course content characteristics were determined from descriptions contained in the plans of instruction (POI) pertaining to the five IM and four WM blocks to be analyzed. Each of the Armed Services has planning documents containing detailed descriptions of lesson objectives and the

distribution of lesson time into categories such as lecture, performance, testing, and outside assignment. The variables selected to describe each lesson were based on information common to these planning documents.

The content of each AIS lesson was identified in the POI on the basis of common objectives. In some cases, the set of objectives covered by a single conventional lesson had been transferred directly to an AIS lesson. In general, however, the conventional lessons were longer than AIS lessons and contained more material. In these cases, two or more artificial conventional lessons were defined, each containing the objectives corresponding to a single AIS lesson. The total instructional time in the conventional lesson and the time allocated to each of the instructional methods by the POI were then distributed across the new, artificial lessons on the basis of the objectives contained in each new lesson. In a similar fashion, if an AIS lesson contained the objectives of two or more conventional lessons, the times within the POI categories were summed to create an artificial conventional lesson. If the depth of content in the conventional lesson had been reduced or increased in the corresponding AIS lesson, the POI times were increased or reduced, by category, by the corresponding amount. Finally, there were some cases in which course content had changed during the AIS implementation period, and no conventional instruction POIs were available which included the new objectives. When this occurred, the AIS lesson containing the new objectives was dropped from the analysis.

These decisions and translations were made by members of the AIS materials development teams and content matter specialists who, in many cases, had previously taught in the conventional courses. The conclusion of this exercise defined a set of AIS lessons in the nine blocks which could be characterized by descriptive statements in actual POIs or in POIs constructed artificially.

It was obvious that one of the most promising predictors of first-attempt-lesson time under a self-paced system would be the amount of time devoted to that lesson under conventional instruction. This variable was defined as total POI time. There was reason to expect, however, that predicted first-attempt-lesson times (hereafter referred to simply as lesson time) would be more accurate if

separate variables were defined for the various categories of instruction outlined by the POI. Four such variables were defined: Lecture/Discussion; Demonstration/Performance; Programmed Instruction/Audio-Visual; and, Outside Assignment.

Each AIS lesson contained only material which pertained directly to the stated objectives. The "nice to know" information which would usually be included in a lecture had been eliminated. Therefore, it was assumed that the amount of time which the POI allocated to lecture and discussion activities would be shortened dramatically under self-pacing.

Under conventional instruction, Demonstration/Performance activities usually involve at least two repetitions of the task to be performed - once by the instructor and once by the student. Under self-pacing, the task was performed only once by the student under step-by-step guidance by the instructional materials. This might be slower or faster than was the case under conventional instruction.

Analysis of the objectives, taught at least in part through Demonstration/Performance activities, suggested that a further breakdown might be profitable. While some of the objectives were primarily psychomotor in nature, others appeared to be primarily cognitive in nature (e.g., troubleshooting). Therefore, two sub-categories were defined: Demonstration/Performance-Cognitive; and Demonstration/Performance-Psychomotor. While the distinction could have been made on a judgmental basis, an alternative approach was employed. Each AIS lesson could, potentially, contain a performance check, supervised by an instructor, as well as a multiple-choice test. If the AIS materials developers had seen fit to include a performance check in the lesson, the POI Lecture/Discussion time was categorized as Psychomotor. Otherwise, the time was categorized as Cognitive.

POI instructional time allocated to programmed instruction or an audio-visual presentation was grouped under a single variable on the assumption that the time required for such activities under self-pacing would not be shortened substantially. Finally, Outside Assignment time was treated separately on the assumption that such activities would be less efficient than if they were conducted in the classroom.

In summary, six quantitative measures of content were defined: The number of minutes allocated by the POI to (a) Lecture/Discussion, (b) Demonstration/Performance-Cognitive, (c) Demonstration Performance-Psychomotor, (d) Programmed Instruction/Audio-Visual, (e) Outside Assignment; and (f) the total number of minutes allocated to the conventional lesson, the sum of the first five measures.

Defining measures of the qualitative characteristics of the content presented a substantially different problem. While several investigators have offered their views regarding the interaction of specific content characteristics and student performance, no one to date has been able to measure the relationship between these content characteristics and rate of learning in an operational environment. The current study employed two distinct approaches to the problem of content classification and conducted a comparative evaluation of the two. The results of this evaluation are discussed in paragraph 4.3.3.1.

The first approach, which will be termed content classification, concentrated directly on the lesson content as described by the POI. Three broad categories were defined: memory, cognitive, and psychomotor. While few attempts have sought to identify such broad categories (most have dealt with more specific factors in well defined environments, e.g., Guilford, (1971), it was thought that this approach would have greater utility to instructional personnel given the task of characterizing course content.

There was a dearth of personnel qualified and available to evaluate each lesson in terms of the percent (later translated into minutes) of memory, cognitive, and psychomotor content involved. For the IM course, two instructors and a third party, not a subject matter expert, were asked to make these ratings jointly on the 29 lessons of interest. Only one subject matter expert was found to make these evaluations for the 35 lessons of interest in the WM course. For each content area represented in these lessons, the raters were asked to judge on a scale of one to five how simple or complex the material appeared to be for the trainee population to whom it was presented. For example, the content of a particular two hour lesson might be judged to be 15 percent (18 minutes) memory and 85 percent (102 minutes) psychomotor. The memory content might be judged as being difficult and given a complexity rating of five. The psychomotor component of the lesson might

be judged to be of medium complexity and given a rating of three. Since the lesson was devoid of cognitive material, no rating was required for that category. The procedure of obtaining content ratings for the IM and WM lessons, either by inter-judge agreement or by a single judge, respectively, made the determination of inter-judge reliability estimates inappropriate.

Definitions and examples of the three categories and of the complexity scales within each category are provided in Table 1. These same definitions were given to the raters to guide their review of the POIs. These ratings served as input to the data base.

The second approach to categorizing lesson content adopted a more conventional method, more oriented toward the terminal behavior described by the objectives stated in the POI. A modification of Merrill's (1972) classification scheme was adopted. Merrill's categories of discriminated recall, classification, rule using, and higher order rule using were supplemented with the category of psychomotor tasks. A binary easy/difficult dimension was then added to each category. Definitions of the five categories and the bases for the easy/difficult decisions are shown in Table 2.

Two psychologists on the AIS project staff classified each objective listed in the relevant portions of the POIs into one of these ten categories. Each lesson was then rated on the basis of the proportion of the content attributable to the objective(s) in each category. For example, a particular lesson might contain four specific performance objectives. Three of the objectives might be classified as Discriminated Recall. Two of these might be judged as Discriminated Recall - Easy and the third, Discriminated Recall - Difficult. The fourth objective might be categorized as an easy classification task. The POI time allocated to the two easy discriminated recall objectives would be assigned to the variable, Discriminated Recall - Easy, for this lesson. The time attributable to the other two objectives would be the values of the variables, Discriminated Recall - Difficult and Classification - Easy. The variables representing the seven remaining categories of terminal behavior or performance, Classification-Difficult through Psychomotor-Difficult would be given values of zero.

TABLE 1
CONTENT CLASSIFICATION: DEFINITION
AND METHOD OF CALCULATION

CONTENT AREA	DESCRIPTION
Memory Related Content	That portion of the lesson content requiring retention of information. Measured in terms of the minutes of conventional instruction.
Memory - Simple/Complex	A five point rating of the simplicity or complexity of the memory related element in the lesson. Simple memory content (one) includes recognition of familiar terms; complex memory content (five) includes recall of many new technical terms.
Cognitive Content	That portion of the content related to knowledge gathering, understanding relationships and principles, and problem solving. Measured in terms of minutes of conventional instruction.
Cognitive - Simple/Complex	A five point rating of the simplicity or complexity of the cognitive element in the lesson. Simple cognitive content (one) involves procedure following, labeling, and information collecting. Complex cognitive content (five) involves symbol manipulation, problem solving, decision making, and evaluation.
Psychomotor Content	That portion of the content related to performance or "hands-on" tasks and involving manual dexterity, eye-hand coordination, or gross motor movements measured in terms of minutes of conventional instruction.
Psychomotor - Simple/Complex	A five point rating of the simplicity or complexity of the performance element. Simple psychomotor content (one) includes gross motor movements. Complex psychomotor content (five) involves fine motor dexterity, complex eye-hand coordination, and precise motor movements.

TABLE 2
BEHAVIOR CLASSIFICATION DEFINITIONS

BEHAVIOR CATEGORY	DEFINITION
Discriminated Recall-Easy Difficult	Given a symbol, object or event, a student responds by providing the associated member of the response set. If the number of members in the stimulus set was large and/or if the members of the response set were unfamiliar (e.g., new technical terms), the objective was judged to be difficult.
Classification-Easy/Difficult	Given a new example from a class of items, a student responds with class membership. The easy/difficult dimension was based on the number of classes.
Rule Using-Easy/Difficult	Given a new experience, a student applies a rule (a set of operations) to produce the appropriate members of the response set. <u>Rule Using-Easy</u> was essentially following written procedures (e.g., technical orders). <u>Rule Using-Difficult</u> was following procedures in the absence of written guidance.
Higher Order Rule Using - Easy/Difficult	Analogous to problem solving activity, the retrieval or generation of rules by applying a higher order rule to determine problem class membership. The easy/difficult dimension was based on the number of steps in the problem solution.
Psychomotor-Easy/Difficult	The performance of fine or gross motor control movements to accomplish a task. The easy/difficult dimension was based on the familiarity or novelty of the task components.

The psychologist raters, although familiar with the AIS courses, were by no means subject matter experts. Therefore, their ratings were checked and, in a few cases, modified, by members of the course materials development teams. This procedure was undertaken as an attempt to provide at least face validity for these ratings. Since independent ratings of the objectives were not obtained, interrater reliability estimates could not be generated.

4.2.2.2 Instructional Design Variables - As was previously discussed, AIS, at the time of this study, included insufficient examples of lessons taught by media other than programmed texts to include alternative media as variables in the predictive model. A similar situation existed with respect to alternative instructional treatments designed to compensate for specific deficiencies. Instructional design considerations were, therefore, limited to "organizers." Organizers were defined as "assists" provided in the instructional material to enhance the trainee's achievement of a behavioral objective.

The most prevalent type of organizers in the AIS materials was the list of objectives at the beginning of each lesson. Since every lesson included such a list, there was no variability across lessons with respect to this factor; and it was, therefore, of no value as a predictor variable.

Two other types of organizers were present which did vary from one lesson to another - embedded questions and self-check items. With the exception of those lessons which were strictly performance oriented, embedded questions were scattered throughout the textual material. Each consisted of a multiple-choice item, the correct answer to which was provided on the last page of the lesson. The majority of the AIS lessons, again excluding performance lessons, included a self-check item to be completed following study of the lesson but prior to the lesson test. These items were also multiple-choice. The student marked his response on chemically treated paper which then revealed whether or not the response was correct.

The number of embedded questions and the number of self-check items were recorded for each of the AIS lesson analyzed. If no items of particular type were present, a zero was recorded. Although this information was taken directly from existing AIS lessons, a tactic which would not be possible if the model were

actually being used to predict the characteristics of a self-paced course yet to be constructed, the number of embedded and self-check items was assumed to reflect instructional design policies which could and should be established prior to actual materials development.

4.2.2.3 Test Characteristics - Consideration of test characteristics was limited to the lesson tests themselves. Due to the inclusion of new material in the AIS lessons, there were no examples of complete blocks. Thus, all of the block tests included some items from lessons which were not sampled for this study.

Three test characteristics were measured for each lesson test. For each lesson which included a multiple-choice test, the number of test items and the test criterion (expressed as a percentage) were recorded. For lessons without multiple-choice tests, a zero was recorded for both number of items and criterion. For each lesson which included a performance test, a situation in which the student was to perform a task to the instructor's satisfaction, the number of specific checkpoints in the performance task was recorded. Again, a zero was recorded for this variable if the lesson did not include a performance test.

4.2.2.4 Student Characteristics - The variables chosen as student characteristics were determined on the basis of (a) the ease with which they could be obtained in a variety of military training environments, (b) how representative they were of a wide variety of individual differences, both cognitive and affective, and (c) their known relationship to the prediction of AIS training time criteria in different types of training courses. Thus, the resulting student characteristic variables include the four primary composite scores from the Armed Services Vocational Aptitude Battery (ASVAB), sex, and selected affective and cognitive variables which were common to the AIS pre-assessment batteries of both the IM and WM courses.

A complete description of each of the selected student characteristic variables is presented in Table 3. The variables are organized in three categories: (a) Armed Services Vocational Aptitude Battery (ASVAB) Variables and sex; (b) Cognitive AIS Pre-Assessment Battery Variables; and (c) Affective AIS Pre-Assessment Battery Variables. Wherever applicable, the references for a particular measure of student characteristic variables are cited.

TABLE 3
STUDENT CHARACTERISTIC VARIABLES

VARIABLE CATEGORY	VARIABLE NAMES	DEFINITION
I. ASVAB Composites and Sex	ASVAB Scores: General Ability Electrical Ability Administrative Ability Mechanical Ability	A standard vocational aptitude battery, administered to all enlisted inductees, which contains four primary composite scores for general, electrical, administrative, and mechanical abilities, respectively.
	Sex	An identifier of individual differences in training times attributable to sex differences, where males = 1, and females = 0.
II. Cognitive AIS Pre-Assessment Variables	Reading Vocabulary Test - Total Scores	A 45-item measure of students' ability to recognize the definition of terms frequently used in Air Force documents (Diegnan, 1973)
	Reading Skills Scales 1 and 2	Course-specific measures of students' reading comprehension and speed on materials extracted from IM and WM technical manuals. Scales 1 and 2, consisting of 10 items each, differ only in terms of difficulty, with longer passages and more rigid time limits imposed on Scale 2 (McCombs, 1974).
	Concealed Figures Test	A 20-item measure of students' ability to make perceptual distinctions by recognizing which of five simple geometrical figures is embedded within a complex pattern (Diegnan, 1974).
III. Affective AIS Pre-Assessment Variables	Pre-Course State Curiosity Scale	A 20-item self-report measure of students' anticipated feelings of interest in learning the IM or WM course materials (Leherissey-McCombs, 1971).
	Pre-Course State Anxiety Scale	A 20-item self-report measure of students' anticipated feelings of tension or apprehension about learning the IM or WM course materials (Spielberger, Gorsuch, & Lushene, 1970).

TABLE 3 (cont.)
STUDENT CHARACTERISTIC VARIABLES

VARIABLE CATEGORY	VARIABLE NAMES	DEFINITION
III. Affective AIS Pre-Assessment Variables (cont.)	Test Anxiety Questionnaire	A 16-item self-report measure of students' tendencies to become anxious when taking ability or achievements tests (Sarason, 1958).
	Internal-External Scale	A 29-item self-report measure of students' tendencies to feel in control of events versus controlled by external events (Rotter, 1966).
	General Media Preference and Instructional Experience Subscales:	A 15-item self-report scale, consisting of five subscales which measure students' general preference for audio versus printed materials, as well as their reported degree of experience with conventional versus self-paced instruction (McCombs, 1974)
	Audio Preference	
	Visual Preference	
	Printed Preference	
	Experience with Con- ventional Institution	
	Experience with Self- Paced Instruction	

The primary rationale for the selection of the four ASVAB variables and sex was that these variables are easily obtained on enlisted trainees in all branches of the military services. In addition, many years of systematic research with the ASVAB battery has shown it to be a highly reliable and valid measure of individual differences in vocational aptitudes. A number of research studies, as well as our own experience with AIS data, have shown sex to be related to individual differences in training times.

Within the Cognitive AIS Pre-Assessment Battery Variables category, three reading ability measures and one perceptual reasoning ability measure were chosen. The reading variables have been shown to be highly predictive of independent variance in training time criteria in each of the four AIS courses. In addition, it was felt that, even though these particular reading measures might not be available in other military applications, similar reading vocabulary, comprehensive, or speed measures were likely to be available. The perceptual reasoning variable, defined by scores on the Concealed Figures Test, was selected on the basis that it was available for both IM and WM students, and it represented a perceptual/reasoning ability that would be generally related to student performance in a variety of technical specialties. At the time this variable was selected, preliminary AIS data indicated that it was moderately related to training times on some of the IM course materials.

The particular measures chosen with the Affective AIS Pre-Assessment Variable category were chosen on the basis of (a) their known relationship to AIS training time criteria; (b) the wide range of student motivations, attitudes, and learning style preferences they represented; and (c) their availability as common predictor variables in both the IM and WM courses. For example, state curiosity, state anxiety, and test anxiety have all been shown to be highly predictive of AIS training time criteria (McCombs and Siering, 1976). Although at the time of this study not much AIS data were available of the Internal-External Scale, it was judged to be a student characteristic variable that would be expected to be highly related to student training times in self-paced instructional environments. Similarly, students' preferences for audio versus visual printed instructional modes of learning, and their experience with self-paced versus conventional instruction were also judged to be important affective predictor variables in self-paced instructional environments.

4.2.3 Creation of Files for Data Analysis - Creating the data files was a lengthy process which involved merging three distinct classes of data:

- o Student data available from the AIS data analysis system: Course; Social Security Number (used by AIS as an ID); sex; preassessment test data; block and lesson number; module number (i.e., instructional alternative type); first-attempt-lesson time; and first-pass-block time
- o Supplementary student data: The ASVAB General, Electrical, Administrative, and Mechanical scores
- o Lesson characteristic data: the POI derived quantitative measures; content classification measures; behavior classification measures; instructional design measures; and test characteristic measures.

Student data were extracted from AIS files representing the nine blocks of the two courses using the AIS Data Extraction Program (DEP). It was necessary to extract data from separate and distinct time periods in order to avoid time periods in which the courses were undergoing substantive changes. The product of this activity was nineteen separate files.

ASVAB scores were not normally recorded in the AIS files since they were not usually available early enough in the course to be of value as predictors. For purposes of this study, however, ASVAB scores were obtained from Air Training Command's Training Management Information System (TRAMIS) for as many of the students as possible represented in the DEP files described above. The scores were obtained on cards, input into the computer, and an additional file was constructed.

A total of 64 lessons was sampled. Twenty-nine of these were from the IM course; six from block one; six from block two, six from block three, four from block four; and seven from block five. The remaining 35 were drawn from the WM course: nine from block nine; eight from block ten; ten from block eleven; and eight from block twelve. Lesson characteristic data were punched on cards, input, and a file was created for each of the nine blocks.

A special purpose program was written to merge files across categories. Each run of this program produced a file containing all relevant data for each of the nineteen DEP files previously created. These nineteen files were then merged into a single tape file containing approximately 13,700 records where each record represented a particular student's first attempt on a lesson of known characteristics. That is, each record contained the relevant characteristics of both the student and the lesson as well as the time required for his first attempt on the lesson.

The magnitude of this file made its retention and manipulation on a disk impractical. The study required two comparable samples, one for regression equation generation and a second for equation validation. Therefore, the file was immediately split into two samples on the basis of whether the final digit of a trainee's Social Security Number was odd or even. After excess records had been deleted from the larger sample, each sample contained 6849 records.

Missing and incorrect data were rampant throughout the developing AIS data base. Typical problems included preassessment forms which were incorrectly read by the system's optical scanner, and trainees who were enrolled without completing any of the preassessment tests. ASVAB scores obtained from TRAMIS were often incomplete or missing entirely. First-attempt-lesson-times contained a small but persistent number of widely deviant values. The primary cause of these outliers was miscoding, e.g., if a student worked on a lesson during two consecutive days, the number of days was often mismarked on the test answer sheet. The measure of first-pass-block-time was also error prone. It was defined as the elapsed time from starting the first lesson in the block until the block test was completed. Errors such as mismarked dates often made this value fallacious.

To reduce these errors as much as possible, sets of constraints were established for these variables. Preassessment scores were recoded as missing values if they were actually missing or exceeded the known limits of the test scores. All ASVAB scores, if present, were determined to be reasonable. First-attempt-lesson-times were limited to a range of fifteen to three-hundred minutes. This eliminated approximately five percent of the data from either end of the distribution. Block times were excluded if the reported time was not greater than the sum of the first-attempt-lesson-times or if the reported time fell outside the range established as reasonable by prior experience with AIS.

The regression analyses was conducted using the (SPSS) Statistical Package for the Social Sciences (Nie, Hull, Jenkins, Steinbrenner, and Brent, 1975). SPSS offers two options with regard to missing data: "pair-wise deletion" which includes all of the data points available for a particular variable in the analysis, and "list or case-wise deletion" which excludes any case from consideration if that case has one or more missing data points in any of the variables included in the analysis. Although the former option is less expensive in terms of lost data, it tends to result in fallaciously high correlation coefficients. Therefore, the case-wise deletion option was selected. This reduced Sample One, the data base to be used for regression equation generation, to 2974 cases, each having a complete set of data points for each variable. It should be noted that this figure does not represent 2974 different students. Varying numbers of observations were generated by individual students. For example, data generated by a particular IM student might be present for the data base for three lessons in Block One and two lessons in Block Two. The implications of these repeated measures are discussed in paragraph 4.3.1 below.

A summarizing list of the variables investigated, their means and standard deviations (based on the final 2974 cases), and their correlation with the criterion variable is shown in Table 4. Given the size of the sample, first order correlations equal to or greater than $R = \pm .05$ are significant ($p < .05$).

4.3 STATISTICAL ANALYSIS AND RESULTS

4.3.1 Description of Statistical Methods - The data were analyzed using several statistical methods, primarily programs from the Statistical Package for the Social Sciences (Nie et al 1975). Available SPSS regression program options were used to constrain data values to reasonable limits and to screen out missing data. The two primary methods employed in obtaining the final prediction equation were linear model comparisons (Ward and Jennings, 1973) and stepwise multiple regression analysis.

In linear model comparisons, two linear models (i.e., regression equations) are compared in terms of the reduction of the multiple correlation coefficient squared (R^2). The model with the larger number of predictors is referred to as

TABLE 4
MEANS, STANDARD DEVIATIONS, AND FIRST ORDER CORRELATIONS OF
PREDICTOR AND CRITERION VARIABLES

VARIABLES	MEAN	STD. DEV.	R WITH CRITERION
<u>COURSE CONTENT VARIABLES</u>			
<u>Quantitative Measures (from POI)</u>			
Lecture/Discussion Minutes	89.54	97.58	.489
Demonstration/Performance Minutes - Cognitive	55.70	64.45	.488
Demonstration/Performance Minutes - Psychomotor	27.91	63.19	-.294
Programmed Instruction/AV Minutes	8.43	38.67	.047
Outside Assignment Minutes	51.27	127.10	.029
<u>Content Classification Measures</u>			
Memory Content Minutes	68.86	71.99	.321
Simple/Complex Memory Rating (1-5)	2.61	0.74	.201
Cognitive Content Minutes	145.67	147.37	.329
Simple/Complex Cognitive Rating (1-5)	2.81	1.05	-.015
Psychomotor Content Minutes	20.95	53.13	-.084
Simple/Complex Psychomotor Rating (1-5)	1.23	1.90	-.239
<u>Behavior Classification Measures (All Values in Minutes)</u>			
Discriminated Recall - Easy	86.13	126.06	.102
Discriminated Recall - Difficult	25.88	58.08	.049
Classification - Easy	1.02	8.72	-.079
Classification - Difficult	(no instances of this category)		
Rule Using - Easy	86.56	111.85	.368
Rule Using - Difficult	4.18	19.43	.138
Higher Order R.U. - Easy	13.13	37.00	.349
Higher Order R.U. - Difficult	1.57	11.82	-.099
Psychomotor - Easy	14.30	36.23	-.122
Psychomotor - Difficult	(no instances of this category)		
<u>INSTRUCTIONAL DESIGN VARIABLES</u>			
No. of Embedded Questions	16.27	15.18	.590
No. of Self-Check Items	2.74	4.54	-.149
<u>TEST CHARACTERISTIC VARIABLES</u>			
No. of Lesson Mastery Test Items	9.38	6.69	.478
Master Test Criterion (Percent)	57.70	29.75	.288
No. of Performance Test Check Points	8.26	19.04	-.279

TABLE 4

MEANS, STANDARD DEVIATIONS AND FIRST ORDER CORRELATIONS OF
PREDICTOR AND CRITERION VARIABLES

(Cont'd)

VARIABLES	MEAN	STD. DEV.	R WITH CRITERION
<u>STUDENT CHARACTERISTIC VARIABLES</u>			
Sex (0 = Female, 1 = Male)	0.87	0.33	-.283
<u>ASVAB Scores</u>			
General	68.85	13.30	-.089
Administrative	59.62	18.47	.149
Mechanical	58.97	25.88	-.384
Electrical	65.98	16.65	-.252
<u>Cognitive AIS Preassessment Scores</u>			
Reading Vocabulary	22.37	6.80	-.041
Reading Skills Scale 1	5.38	1.80	-.160
Reading Skills Scale 2	5.18	2.18	.218
Concealed Figures	7.96	3.60	-.042
<u>Affective AIS Preassessment Scores</u>			
State Curiosity	65.76	7.77	-.049
State Anxiety	38.89	8.36	.084
Test Anxiety	30.11	7.57	.182
Internal-External	14.43	3.88	-.021
Audio Preference	11.09	3.04	-.007
Visual Preference	7.89	2.22	-.147
Printed Preference	4.39	1.44	.069
Conventional Instruction Experience	6.94	1.64	-.012
Self-Paced Instruction Experience	5.45	1.35	-.095
<u>CRITERION VARIABLE</u>			
First-Attempt-Lesson Time	84.90	64.74	-

the full model, and the model with the smaller number of predictors is called the restricted model. The reduction in R^2 is F distributed with degrees of freedom df_1/df_2 according to the following equation.

$$F = \frac{(R_f^2 - R_r^2) / (df)_1}{(1 - R_f^2) / (df)_2}$$

where $R_f^2 = R^2$ of the full model,

$R_r^2 = R^2$ of the restricted model,

$(df)_1 = n_f - n_r$, the difference between the number of linearly independent predictor vectors of the full (n_f) and restricted (n_r) models, and

$(df)_2 = N - n_f$ where N is the total number of cases.

For the linear model comparisons in this study, SPSS regression program options were used to delete predictor variables and to generate composite predictors. The R^2 values were obtained from the SPSS program, and the F values were obtained from a FORTRAN program produced by the AIS project staff. Stepwise multiple regression analysis is simply multiple regression analysis performed by adding, step by step, the predictor variable which yields the highest F value for the increase in R^2 according to the above equation. The SPSS multiple regression programs include a stepwise option which was employed where appropriate for this study.

The models employed in this series of linear model comparisons did not control for the effect of repeated measures on the lesson variables. There are several reasons why this was not done. First, one controls for the effect of a particular variable, e.g., subjects, to increase the precision of an F-test between two models. The very large n in this study provided sufficient precision so that additional control over extraneous error variance was not necessary. In general, the F-tests resulting from model comparisons were highly significant. Second, the effects of the repeated measures were curtailed by the fact that the repeated observations for a given subject were for different lessons (different learning tasks) rather than on the same lesson and that subjects with repeated measures varied with regard to the sets of lessons on which the measures were repeated. Third, to control for the repeated measures would have required the generation of a binary vector to represent each individual student. This would have far exceeded the capacity of the SPSS program. Finally, it must be remembered that the purpose

of the resultant regression model was to predict first-attempt-lesson-time given only the characteristics of the lesson and of a generally defined student population. Thus, the user of the prediction equation would have no means by which to identify individual students.

Cross validation of the final regression equation model also employed the SPSS regression program. SPSS regression program options were used to define a variable, predicted first-attempt-lesson-time, which was the result of the application of the final regression equation to data from Sample Two. The values of this variable were then correlated with actual Sample Two, first-attempt-lesson-times.

4.3.2 Elimination of Two Variables Highly Correlated with the Criterion - Early analyses indicated the presence of two variables which were highly correlated with the criterion of first-attempt-lesson-time. These were the instructional design variables, Number of Embedded Questions ($r = .590$), and the test characteristic variable, Number of Lesson Test Items ($r = .478$). Since these variables were also highly correlated with a number of other variables, they tended to mask the relevance of these potential predictors and accounted for more of the variability than was logically justified.

It will be recalled that the numbers of Embedded Questions and Lesson Test Items were taken directly from existing AIS materials. This action was justified on the assumption that the numbers of items reflected instructional design decisions which could be made prior to the development of self-paced materials. Unfortunately for this study, AIS material developers employed a consistent policy with regard to the number of embedded and lesson test questions throughout their instructional development effort in both of the courses sampled. Thus, almost all of the variability in these two variables could be traced directly to the amount of subject matter content in each lesson and, hence, its average first-attempt-time. Since the current study was basically a survey, and direct manipulation of the various predictor variables was not feasible, some problems of this type had to be expected. Despite the resultant loss of predictability, it was imperative that these two variables be deleted from the predictor set in order to obtain a realistic assessment of the relevance of the remaining variables.

Two linear model comparisons were made in eliminating these two variables. The full regression model, prior to elimination of the variables, contained 34 predictors - all of those, other than the behavior classification measures, are shown in Table 4. The multiple correlation coefficient obtained was .68599, $R^2 = .47058$. Elimination of the Embedded Questions variable reduced proportion of the variance accounted for to $R^2 = .42525$. A test for the significance of the reduction in R^2 resulted in an $F(1, 2939) = 251.643$, $p < .001$. When the variable Number of Lesson Test Items was removed, R^2 was further reduced to .40413, $F(1, 2940) = 108.034$, $p < .001$.

4.3.3 Reduction of Predictor Set Through Linear Models Comparisons - A series of linear model comparisons was made in order systematically to obtain a more parsimonious set of predictor variables. Although the specific questions of interest could have been asked by isolating the relevant variables, it was considered more appropriate that the comparisons be made in the context of the complete set of remaining predictors. In all of the comparisons to be discussed, emphasis was placed on cost-effectiveness rather than on statistical significance. Due to the magnitude of the data base, almost all of the linear model comparisons resulted in significant differences. In general, however, the increased cost of obtaining data required by the additional variables in the full model did not appear to be justified by the increment in predictability provided by the full model. Therefore, the decision rule adopted was to select the restricted model unless the reduction in R^2 approached or exceeded .01000.

4.3.3.1 Course Content and Behavior Classification Measures - An obvious first step in reducing the variable set was to select one of the two approaches for classifying course content. Prior to comparing the two approaches, however, the extent to which the number of variables in each set could be reduced was investigated. The content classification scheme was attacked first.

The initial full model, Model 1, contained the 32 variables remaining after Number of Embedded Questions and Number of Lesson Test Items had been deleted and excluding the behavior classification variables. The multiple correlation generated by Model 1 was .63572, $R^2 = .40413$.

The first question asked concerned whether the simplicity/complexity dimension employed by this approach added substantially to the scheme's predictive utility. A restricted model, Model 2, was defined from Model 1 by deleting the following three rating scale variables: Memory - Simple/Complex; Cognitive - Simple/Complex; and Psychomotor - Simple/Complex. Model 2 resulted in an R^2 of .38395, a reduction from Model 1 of .02018, $F(3, 2941) = 33.200$, $p < .001$. This was considered to be too great a loss in predictability for the cost of obtaining the simple/complex ratings, and the decision was made to retain the rating scales, i.e., Model 1.

Attention was then directed to the behavior classification approach. A full model, Model 3, was defined which consisted of 34 predictor variables. Model 3 differed from Model 1 in that the eight behavior classification measures were substituted for the six content classification measures. As was noted in Table 4, the lessons sampled provided data for only eight of the ten behavior classification measures. No instances of Difficult Classification or Difficult Psychomotor tasks were encountered.

Model 3 resulted in an R^2 of .36057 as compared with an R^2 of .40413 for Model 1. Thus, it was immediately obvious that the content classification approach was preferable in terms of level of predictability. The proposed questions of interest regarding the behavior classification approach were conducted anyway.

The first question asked was similar to that asked regarding the content classification scheme - could the easy/difficult dimension be dropped without substantive loss in predictability? A restricted model, Model 4, was defined in which the eight available behavior classification predictor variables were reduced to five. The values of Discriminated Recall-Easy and -Difficult, were added together to produce a simple Discriminated Recall variable. The same procedure was repeated with respect to Rule Using-Easy and -Difficult and Higher Order Rule Using-Easy and -Difficult. Model 4 resulted in an R^2 of .35451, a reduction from Model 3 of .00606, $F(3, 2939) = 9.285$, $p < .001$. Since the reduction in R^2 was substantially less than 0.01, deletion of this dimension would appear justified in view of the difficulty of obtaining the easy/difficult ratings and their probable unreliability.

A second question was concerned with the utility of the behavior category Higher Order Rule Using. Relatively few of the lesson samples contained examples of this type of behavior. It was thought that this might well be a typical circumstance in military technical training where even most troubleshooting tasks have largely been reduced to a procedure-following activity. Therefore, a further restricted model, Model 5, was defined in which the values of the variables Higher Order Rule Using and Rule Using were added together to produce a single Rule Using variable. Model 5 resulted in an R^2 of .35443, a reduction from Model 4 of only .00008, $F(1, 2942) = 0.365$, $p = .546$. This was obviously not a sufficiently substantive loss in predictability to justify generation of the two separate categories Rule Using and Higher Order Rule Using.

As was mentioned above, the full behavior classification model (Model 3) resulted in a smaller R^2 than did the final content classification model (Model 1). This was despite the fact that Model 1 contained fewer predictor variables (32) than did Model 3 (34). An F test was therefore inappropriate as well as unnecessary, and Model 1 was selected. That is, the six content classification variables were retained as predictors, and the behavior classification variables were deleted from the predictor set.

Of the two approaches, the content classification scheme was also considered more desirable on practical grounds. It will be recalled that the content ratings were generated by course materials development and instructional personnel, the type of personnel who would be most readily available to rate the content of a course being considered for self-pacing. The more esoteric behavior classification scheme was conducted by instructional psychologists familiar with the behavioral concepts and terminology. It can be assumed that more extensive rater training would be required if course personnel were required to produce the behavior ratings.

4.3.3.2 Quantitative Course Content Measures - It will be recalled that the time allocated to the conventional lesson by the POI was broken down into five categories: Lecture/Discussion; Demonstration/Performance-Cognitive; Demonstration/Performance-Psychomotor; Programmed Instruction/AV; and Outside Assignment. The question of interest concerned the necessity of these five categories. The most likely

candidate for reduction appeared to be the Cognitive and Psychomotor subsets of Demonstration/Performance time. The model resulting from the course content comparisons, Model 1, was employed as the full model. The restricted model, Model 6, differed from Model 1 in that it included only a single Demonstration/Performance variable, and was generated by summing the values of the Demonstration/Performance-Cognitive and -Psychomotor variables in Model 1. Model 6 resulted in R^2 of .38800, a reduction from Model 1 of .01613, $F(1, 294) = 79.612$, $p < .001$. The cost of generating these two sub-categories was considered justified by the increased predictability. Model 1 was again retained.

The overall utility of breaking total conventional lesson time down into five components was of some interest. To investigate this question, Model 1 was again employed as the full model, and a restricted model, Model 7, was defined which contained a single quantitative measure of course content - the total number of minutes allocated to the lesson by the POI. This variable was generated by summing the values of the five component times. Model 7 resulted in an R^2 of .29748, a reduction from Model 1 of .10665, $F(1, 2941) = 131.597$, $p < .001$. There would appear to be no question but that the use of the individual component times is well justified.

4.3.3.3 Student Characteristic Measures - The final set of comparisons connected the utility of the various AIS pre-assessment measures. While it can be assumed that ASVAB scores will generally be available, the cost of obtaining data comparable to the pre-assessment measures could only be justified if they made a substantial contribution to the predictive model's utility. Of the two categories of pre-assessment measures, the affective measures were considered the most promising. It was reasoned that the cognitive measures would probably not add much to a predictor set which already contained ASVAB scores. A restricted model, Model 8, was defined from which the four cognitive pre-assessment measures were deleted. Model 1 was employed as the full model. The restricted model resulted in an R^2 of .40230, a reduction from Model 1 of only .00183. This difference was not significant ($F(4, 2941) = 2.258$, $p = .061$). The restricted model, Model 8, was therefore selected.

Finally, the effect of deleting the affective variables was evaluated. Model 8 was employed as the full model, and a restricted model, Model 9, was defined which contained no pre-assessment variables. Model 9 generated an R^2 of .39578, a reduction from Model 8 of .00652, $F(9, 2945) = 3.570$, $p < .001$. Although the difference was significant, the increased predictability contributed by the affective pre-assessment measures was not considered to justify their cost for this application. Therefore, Model 9 was retained as the final predictor set.

The limited utility of the preassessment variables for this study should not be generalized to their function as predictors in an individualized instructional system. The preassessment variables selected were those common to both the IM and WM courses; however, the course content levels sampled by this study were much more heterogeneous than would generally be expected in a single, technical training course. Course-specific, individual difference measures of the type represented in the AIS preassessment battery could well provide the finer differentiation required when dealing with students in a single course. More importantly, it must be remembered that the initial CMI mode of AIS operation from which this Study's data were drawn did not include individualized assignment of instructional alternatives. If a proposed self-paced course were to include alternative instructional treatments assigned on an individual basis, measures such as those in the pre-assessment battery could well make a substantive contribution in a predictive model.

4.3.4 Resultant Regression Model to Predict First-Attempt-Lesson-Time - The 19 variables contained in Model 9 were submitted to the SPSS stepwise Multiple Linear Regression Analysis program. On the basis of this analysis, 14 of the 19 variables were selected for the final regression equation. The cutoff was made at the point at which no one of the remaining variables significantly ($p < .01$) increased the overall multiple correlation. The final 14 variables, their coefficients to five significant digits, and the multiple R and R^2 at each step are shown in Table 5 in their order of entry into the regression equation.

The final regression equation produced a multiple R of .62832, thus accounting for 39.48 percent of the variance in first-attempt-lesson-time for Sample 1. All of the five quantitative course content measures entered the equation. As would be expected, the time required to teach the lesson in the conventional course was

TABLE 5
MULTIPLE LINEAR REGRESSION EQUATION
PREDICTING
FIRST ATTEMPT LESSON TIME

VARIABLE	COEFFICIENT	BETA WEIGHT	MULTIPLE R	R ²
Constant	58.136			
Lecture/Discussion Minutes	0.11689	0.17618	.4886	.2388
Demonstration/Performance Minutes-Cognitive	0.25768	0.25651	.5608	.3145
ASVAB Mechanical Score	-0.26054	-0.10415	.5764	.3322
Memory Content Minutes	-0.17944	-0.19951	.5883	.3461
Simple/Complex Memory Rating	14.928	0.17171	.6005	.3606
No. of Self Check Items	-0.98747	-0.069196	.6047	.3657
Psychomotor Content Minutes	-0.20393	-0.16736	.6098	.3719
Programmed Instruction/AV Minutes	0.27739	0.16567	.6203	.3848
Sex	-16.202	-0.083742	.6238	.3891
Demonstration/Performance Minutes-Psychomotor	-0.088128	-0.086009	.6255	.3913
ASVAB Administrative Score	-0.10187	-0.029058	.6261	.3919
Simple/Complex Psychomotor Rating	1.9439	0.056918	.6266	.3927
Cognitive Content Minutes	0.15746	0.35841	.6272	.3934
Outside Assignment Minutes	-0.14308	-0.28089	.6283	.3948

strongly related to the self-paced lesson completion time. Five of the six content classification measures were included. It is interesting to note that the measures Memory Content Minutes and Psychomotor Content Minutes were inversely correlated with the criterion, i.e., the greater the amount of this type of content, the shorter the first-attempt-lesson-time. This implies that substantial time reductions can be realized through self-pacing in these areas. The one remaining instructional design variable, Number of Self-Check Items, also entered with a negative coefficient. This would imply that the time required for such post-instructional organizers is more than justified. Neither of the two remaining test characteristic variables, Lesson Test Criterion or Number of Performance Test Check Points was found to contribute significantly to the multiple regression equation. With regard to student characteristic variables, sex was found to be relevant, entering with a negative coefficient implying that, for the material sampled, males tend to progress more quickly than do females. Finally, the ASVAB Mechanical and Administrative scores entered with, as would be expected, negative coefficients. Given the presence of those two scores, ASVAB General was not found to contribute significantly to the equation.

4.3.5 Test of the Model's Validity and Generality - The generality of the regression equation model was evaluated by two means, cross validation and a test of course independence. The same constraints which had been applied to Sample One were applied to the 6849 cases in Sample Two, which, along with the casewise deletion of mission data, reduced the sample size to 2830 cases. The Sample Two means and standard deviations of the 14 predictor variables and the criterion variable are shown in Table 6. The comparable Sample One values are also shown for the sake of comparison.

For the cross validation, the final regression equation, shown in Table 5, was applied to the Sample Two data. The resultant distribution of predicted first-attempt-lesson-times had a mean of 83.91 and a standard deviation of 39.23. The correlation between the predicted and actual first-attempt-lesson-times was .5843, $R^2 = .3414$ with a standard error of estimate of 50.62 minutes. This correlation was significantly greater than .000 ($F(1, 2828) = 1465.840, p < .001$). Since the original multiple correlation coefficient was .6283, the shrinkage in cross validation amounted to .04400. In terms of R^2 , the loss in percentage of the

TABLE 6
MEANS AND STANDARD DEVIATIONS OF RELEVANT VARIABLES FROM
SAMPLE USED TO GENERATE REGRESSION EQUATION (SAMPLE ONE)
AND SAMPLE USED FOR CROSS VALIDATION (SAMPLE TWO)

VARIABLE	SAMPLE ONE		SAMPLE TWO	
	MEAN	STD. DEV.	MEAN	STD. DEV.
<u>COURSE CONTENT VARIABLES</u>				
<u>Quantitative Measures</u>				
Lecture/Discussion Minutes	89.54	97.58	88.00	95.19
Demonstration/Performance Minutes-Cognitive	55.70	64.45	53.74	63.10
Demonstration/Performance Minutes - Psychomotor	27.91	63.19	27.75	62.42
Programmed Instruction/AV Minutes	8.43	38.67	8.42	38.39
Outside Assignment Minutes	51.27	127.10	49.65	120.21
<u>Content Classification Measures</u>				
Memory Content Minutes	68.86	71.99	68.57	72.33
Simple/Complex Memory Rating	2.61	0.74	2.62	0.75
Cognitive Content Minutes	145.67	147.37	140.26	142.48
Psychomotor Content Minutes	20.95	53.13	20.83	51.18
Simple/Complex Psychomotor Rating	1.23	1.90	1.25	1.93
<u>Instructional Design Variables</u>				
No. of Self-Check Items	2.74	4.54	2.85	4.65
<u>STUDENT CHARACTERISTIC</u>				
Sex (0 = Female, 1 = Male)	0.87	0.33	0.88	0.33
<u>ASVAB Scores</u>				
ASVAB Administrative	59.62	18.47	59.93	18.47
ASVAB Mechanical	58.97	25.88	57.19	22.90
<u>CRITERION VARIABLE</u>				
First Attempt Lesson Time	84.90	64.74	80.10	62.36

variance accounted for amounted to 5.34 percent. The results of the cross validation were considered to be quite satisfactory. It may be concluded that, when applied to data comparable to that used for equation generation, the regression equation model can satisfactorily predict first-attempt-lesson-times.

The question remained, however, as to the extent to which the model would provide satisfactory predictions of first-attempt-lesson-times for a new course, one containing a different type of subject matter. That is, to what extent could the model be generalized to courses other than those employed in the data base? A thorough evaluation of the model's generality would have required the construction of a new data base and was, unfortunately, beyond the scope of the current study. However, a partial test could be made through use of the available data base.

It will be recalled that the data base sampled a total of sixty-four lessons from two courses: twenty-nine from IM, and thirty-five from WM. The question of model generality was rephrased to ask to what extent did unmeasured characteristics of these two courses, i.e., factors specific to each course, contribute to the variability in first-attempt-lesson-time. That is, to what extent could the variance accounted for be increased by knowledge of the course from which the lessons and students were drawn? The degree to which knowledge of course membership increased predictability could be taken as a rough measure of the limitation of the model generality.

A linear models comparison was employed in which the restricted model, Model 10, was defined as containing the 14 variables in the final regression equation. A full model, Model 11, was defined which contained, in addition, a variable representing course number (IM = 1, WM = 4). The full model resulted in an R^2 of .41300. The restricted model, the final regression equation, produced an R^2 value of .3948, a reduction of .01820. This represented a significant reduction ($F(1, 2958) = 91.71, p < .001$). Thus, specific course membership accounted for an additional 2.0 percent of the variance.

Although significant, the amount of variance accounted for by knowledge of course membership is relatively small. Although some loss in predictability could be expected if the regression equation model were applied to a new course, the results of this final comparison imply that the accuracy of prediction would not be seriously diminished.

4.3.6 Generation of Block-Completion-Times from First-Attempt-Lesson-Times - As was discussed in paragraph 4.2.1, Definition of the Criterion Variable, the criterion variable of interest was block-completion-time. It was, however, necessary to develop the regression equation at the lesson level rather than at the block level in order to obtain sufficient variability in content. Having generated the regression equation, it was now necessary to provide a transition to block level prediction. As was outlined in paragraph 4.2.1, the approach employed was to determine a proportional "lost time" for block completion and the sum of the completion times for all the lessons contained in the block.

As was discussed in paragraph 4.2.3 of this report, none of the nine block samples from the two courses contained a complete set of lessons. This was due to the fact that there were AIS lessons in each block which represented new content, content for which no conventional instruction POIs were available. Since there was no basis for establishing course content predictor variables for these lessons, they were excluded from consideration. Since the data base constructed for this study did not contain any examples of complete blocks, it was necessary to return to the AIS database to obtain the required information, i.e., block-completion-times and first-attempt-times for all of the lessons in each block.

Data were retrieved from each of the nine blocks employed in the current study. A student's data were included in this analysis only if reliable first-attempt-lesson-times were available for all lessons in the block, both those included in the original analyses and those which had previously been excluded. Furthermore, a student's data were excluded if (a) the recorded block-completion-time was less than the sum of the first-attempt-lesson-times or (b) if block-completion-time exceeded reasonable maximums identified by the AIS materials developers. For each student who met these constraints, two values were generated: (a) the sum of first-attempt-lesson times; and (b) block-completion-time. The difference between

these two values was then expressed as a proportion of the sum of first-attempt-lesson-times. This constituted the "lost time" ratio for that student. A mean lost time **was** then calculated for each of these nine blocks. A final mean was determined on the basis of these nine values. The reason for computing the mean in two steps rather than simply summing across blocks was to avoid biases introduced by unequal numbers of observations in the various blocks.

The resultant lost time ratio was 0.40. That is, on the average, block completion time was found to equal $1.40 \times (\text{sum of first-attempt-lesson-times})$. As may be seen by reference to the Descriptive Model (Figure 2), this unmeasured lost time was comprised of the time attributable to the following activities: (a) queuing for lesson resources and test scoring (relatively negligible times); (b) remedial study, queuing and retesting on failed lessons; (c) administrative overhead; (d) credentialling testing and queuing for test scoring; and (e) block level remediation following failure of a credentialling test. In the Cost Model, to be discussed in Section 5.0 of this report, the product of the regression equation was multiplied by 1.40 to obtain an estimate of block-completion-time.

5.0 THE COST MODEL

One of the objectives of this study was the modification of a cost analysis computer program previously developed by the Rand Corporation. Specifically, the Rand model was reprogrammed to use the regression equation developed in this study as the method for generating predictions of course completion times for students. The unmodified Rand model uses a completion time entered by the user without specifying how this time was estimated.

The Rand MODIA cost model (Hess and Kanter, 1976) is actually comprised of three computer programs: a user interface program (UI); a resource utilization model (RUM); and a cost analysis program (MODCOM). The UI is an interactive program which produces a course description in computer-compatible data which can be input into the RUM. The RUM is a batch program which produces detailed course operation reports regarding student flow patterns and waiting times as well as resource demand and utilization. The UI and RUM are designed to be used repeatedly until the course planner has generated several course designs. The costs of these alternative course descriptions are then compared by the batch process cost model program (MODCOM). Resource requirements from the UI, RUM, user supplied course completion times, and cost and manning data are input into MODCOM to produce total course costs for up to five years. On some of the cost and manning factors, default values are used if not supplied by the analyst.

The computer program developed in this study is named Aid for Instructional Development and Evaluation (AIDE). It is a modification of the MODCOM cost analysis program and retains all of the cost analysis features and outputs of MODCOM while allowing for course completion time to be estimated by the regression equation developed in this study.

Although AIDE inputs are sufficiently documented in this report for it to be used by itself, it is designed to be used as a replacement for MODCOM in the MODIA series of programs, and the detailed MODCOM documentation should be used with AIDE.

5.1 DESCRIPTION AND USE OF THE AIDE PROGRAM

The AIDE program projects the investment and operating costs of a given course design for a five-year time frame. Course completion time for each type of student is computed and used to calculate student pay and allowances costs. The number of student entrants per year and their completion times are used to determine resource requirements and costs. Resources include manpower, courseware, hardware, and facilities. These resources require specification in terms of quantities such as attrition rates, and utilization rates. These specifications are outputs of the MODIA UI and RUM programs or may be supplied from knowledge of a specific course. Flexibility in the inputs required allows the model to be used at any level of detail desired.

The following outputs are generated by the AIDE program:

- o Input Data Listing
- o Input Lesson Descriptor Values Listing
- o Course Completion Data Generated by the Regression Model
- o Personnel Distributions and Cost Factors
- o Graduate Summary
- o Manpower Summary
- o Courseware, Hardware, and Facilities Requirements by Year
- o Functional Cost Summary.

These outputs are illustrated in Figures A-1 through A-8 in Appendix A. AIDE outputs 4 through 8 are identical with the original MODCOM outputs. Output 1 differs only in that the additional student and lesson variables unique to AIDE are listed. Outputs 2 and 3 are unique to AIDE. Output 2 provides a complete list of the input lesson descriptor variables, and Output 3 is a summary of the course completion data generated by the regression equation.

A description of input data preparation is given in Appendix A. A more detailed description of the data input is provided by the RAND MODCOM documentation. Any differences in input data preparation between AIDE and MODCOM are noted specifically in Appendix A. In general, the differences

between the two programs are that the AIDE regression equation requires input of values for three student descriptor variables for each type of student defined and values for the eleven course descriptor variables. The particular regression equation developed in this study is currently hardcoded in the AIDE program, but AIDE could be changed to employ any similar regression equation with only minor changes to the FORTRAN code (as noted in Appendix A).

One limitation of the AIDE cost analysis program is that, while there is variability in the predicted course completion times generated by the regression equation, no corresponding variability is computed for course costs by the cost model.

Although AIDE can take up to 75 different lessons as defined by their lesson descriptor variables, it should be noted that the original (conventional course) lesson lengths in this study were approximately one to seven hours. Thus, the prediction equation for individualized lesson and completion times should not be generalized to lessons whose original lengths fall outside this range. Regarding input data preparation, original course lengths outside of this range should be broken down into sums of lessons whose lengths fall within the above range.

5.2 EXAMPLE USE OF AIDE

To illustrate how the AIDE program can be exercised, course completion and cost data were generated for a standard sample and for additional samples representing three specific questions discussed in paragraphs 5.2.1 through 5.2.3.

Input data for all of these samples were obtained primarily from example values given in the MODIA documentation, but a number of values were representative of available AIS data. Specifically, these values were (a) a conventional course length of 50 hours, (b) a student washout rate of 10 percent, (c) a student entry interval of once per 30 hours, (d) a total student entry rate of 3200 per year or approximately 60 per week, (e) lesson descriptor variables, and (f) student characteristic variables. For the standard sample, an approximate normal distribution of student

variable values was chosen for the ASVAB Administrative (ASVADM) and Mechanical (ASVAMEC) scores. The mean values of these two distributions were set equal to the mean values of Sample One from the regression analysis section of this study. Sex was held constant by defining an all male sample. Likewise, student personnel type, designation, and paygrade value were held constant for all students at values derived from the MODIA documentation.

Figures A-1 through A-8 in Appendix A illustrate the AIDE output for this standard sample. Figure A-2 lists the values of the lesson variables, and Figure A-3 lists the values of the student variables. The standard sample time and cost results are summarized in Table 7. The first portion of the table, Course Completion Data, is derived from the AIDE program Output 3 (Figure A-3 in Appendix A). It lists the expected course completion times for students of five differing ability levels as measured by the ASVAB Administrative (ASVADM) and Mechanical (ASVMEC) scales. The average expected course completion time across all students is shown to be 19.17 hours, a savings of 52.1 percent from the conventional course length of 40 hours. The second portion of the table, the Functional Five Year Cost Summary, is derived from AIDE Output 8 (Figure A-8 in Appendix A). The figures shown for each category are totals over the initial five year period assuming the distribution of student ability levels shown in the top portion of the table. The various cost items are described on pages A-27 and -28 of Appendix A.

TABLE 7
AIDE TEST RUN FOR STANDARD SAMPLE

COURSE COMPLETION DATA (IN HOURS)

Student Variables		Course Completion Time (Hrs.)
ASVADM	ASVMEC	
84	85	17.0
72	72	18.1
60	59	19.2
48	46	20.2
36	33	21.3

Average Course Completion Time is 19.17 Hours

Average time Savings is 52.1 Percent

FUNCTIONAL FIVE YEAR COST SUMMARY

Courseware Procurement

Printed Media	\$136,700
Display Media	48,000
Software	13,100

Hardware Procurement

Media Hardware	22,400
Special Equipment	0
Overhead Hardware	2,000

Facility Construction 75,000

Pay and Allowances

Students	1091,700
Instructors	1644,800
Curriculum Personnel	79,300
Facilities Maintenance Personnel	204,500
Training Admin. Personnel	60,000
Base Operating Support Personnel	335,000
Medical Personnel	59,100

PCS Costs

Students	7166,700
Instructors	25,400

Instructor Training

Factory Training of Initial Cadre	3,000
Education Training	54,200

Miscellaneous Operating Costs

Computer Service Charges	330,000
Hardware Replenishment/Repair	8,000
Miscellaneous Supplies	43,400

TOTAL COURSE COST \$11,675,600

It should be understood that the purpose here was to illustrate how the cost model can be exercised, not to provide an accurate description of the cost structure of an AIS course. If the data were to be representative of an AIS course, it would be necessary to increase the number of lessons in the sample from ten to about 120, and a number of additional inputs would need to be modified to be representative of either the IM or WM course characteristics and students.

5.2.1 Effect of Variation in Student Aptitude Level - The first question investigated asked how cost would be affected if the average level of student aptitude is increased or decreased where aptitude is measured by the ASVAB Administrative and Mechanical scores. The purpose of this particular question was to represent a situation in which an administrator might wish to learn the effects on course costs of lowering course entry requirements (a possible outcome of zero draft) or of raising them (a possible outcome of increased unemployment in the civilian sector).

Two more distributions of student variables were generated which were also approximately normal and whose ASVADM and ASVMEC means were two-thirds of a standard deviation below and one-half of a standard deviation above the mean of the standard sample, respectively. The distributions employed (including the standard sample) are illustrated in Table 8. For each sample, the same number of students was input for each of five years, and all other input variables were held constant. With an entry interval of one week (30 hours), the entry rate was 64 students per week, roughly the number of weekly student entries in the AIS IM course at Lowry AFB.

TABLE 8
DISTRIBUTIONS OF STUDENT VARIABLES FOR COMPARISON OF
STANDARD, BELOW AVERAGE, AND ABOVE AVERAGE STUDENT POPULATIONS

SAMPLE DESCRIPTION	ASVADM	ASVMEC	STUDENT ENTRANTS PER YEAR
Standard Sample	84	85	200
	72	72	800
	60	59	1200
	48	46	800
	36	33	200
Above Average Sample	96	98	200
	84	85	800
	72	72	1200
	60	59	800
	48	46	200
Below Average Sample	72	72	200
	60	59	800
	48	46	1200
	36	33	800
	24	20	200

The time and cost results for the two Above and Below Average student samples are given in Tables 9-1 and 9-2, respectively. These Tables are in the same format as Table 7, and the data were derived from the same AIDE program outputs, i.e., Output 3 and Output 8.

For purposes of comparison, data from Tables 7, 9-1 and 9-2 are summarized

TABLE 9-1

AIDE TEST RUN FOR ABOVE AVERAGE STUDENT SAMPLE
COURSE COMPLETION DATA (IN HOURS)

STUDENT VARIABLES		COURSE COMPLETION TIME (HRS.)
ASVADM	ASVMEC	
96	85	16.7
84	72	17.8
72	59	18.9
60	46	20.0
48	33	21.0

Average Course Completion Time is 18.88 Hours

Average Time Savings is 52.8 Percent

FUNCTIONAL FIVE YEAR COST SUMMARY

Courseware Procurement

Printed Media	\$ 136,700
Display Media	48,000
Software	13,100

Hardware Procurement

Media Hardware	20,900
Special Equipment	0
Overhead Hardware	1,800

Facility Construction	75,000
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Pay and Allowances

Students	1075,700
Instructors	1644,800
Curriculum Personnel	79,300
Hardware Maintenance Personnel	195,000
Facilities Maintenance Personnel	60,000
Training Admin. Personnel	335,000
Base Operating Support Personnel	273,300
Medical Personnel	59,100

PCS Costs

Students	7166,700
Instructors	25,400

Instructor Training

Factory Training of Initial Cadre	3,000
Education Training	54,200

Miscellaneous Operating Costs

Computer Service Charges	330,000
Hardware Replenishment/Repair	7,500
Miscellaneous Supplies	42,900

TOTAL COURSE COST	\$11,647,400
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TABLE 9-2

AIDE TEST RUN FOR BELOW AVERAGE STUDENT SAMPLE

COURSE COMPLETION DATA (IN HOURS)

STUDENT VARIABLES		COURSE COMPLETION TIME (HRS.)
ASVADM	ASVMEC	
72	85	17.3
60	72	18.4
48	59	19.5
36	46	20.5
24	33	21.6

Average Course Completion Time is 19.45 Hours

Average Time Saving is 51.4 Percent

FUNCTIONAL FIVE YEAR COST SUMMARY

Courseware Procurement

Printed Media	\$ 136,700
Display Media	48,000
Software	13,100

Hardware Procurement

Media Hardware	22,400
Special Equipment	0
Overhead Hardware	2,000

Facility Construction 75,000

Pay and Allowances

Students	1108,100
Instructors	1644,800
Curriculum Personnel	79,300
Hardware Maintenance Personnel	204,500
Facilities Maintenance Personnel	60,000
Training Admin. Personnel	335,000
Base Operating Support Personnel	278,300
Medical Personnel	59,100

PCS Costs

Students	7166,700
Instructors	25,400

Instructor Training

Factory Training of Initial Cadre	3,000
Education Training	54,200

Miscellaneous Operating Costs

Computer Service Charges	330,000
Hardware Replenishment/Repair	8,000
Miscellaneous Supplies	43,900

TOTAL COURSE COST \$11,697,500

in Table 10. As may be seen from Table 10, dramatic variations in aptitude in the student population, as measured by the ASVAB Administrative and Mechanical scores, have relatively little effect on course completion time, approximately 1.5 percent. This is due to the fact that, in the regression equation employed (see Table 5), these two variables, although significant, account for relatively little of the variability in first-attempt-lesson-time. The effect on Total Course Cost is even less, approximately 0.2 percent. This is due to the relatively large fraction of the course costs which are considered by the model to be fixed rather than dependent on variable course length.

TABLE 10
TIME AND COST COMPARISONS FOR DIFFERENT STUDENT DISTRIBUTIONS

SAMPLE DESCRIPTION	AVERAGE TIME		STUDENT PAY COST		TOTAL COURSE COST	
	Hours	% Change	\$*	% Change	\$*	% Change
Above Average	18.88	-1.5	1075.7	-1.5	11647.4	-0.24
Standard	19.17	0.0	1091.7	0.0	11675.6	0.00
Below Average	19.45	1.4	1108.1	1.5	11697.5	0.19

* In Thousands of Dollars

5.2.2 Effect of Variation of Proportion of Memory Versus Cognitive Content -

The second question investigated the effect of variations in the relative proportions of Memory to Cognitive content. The purpose of this question was to illustrate the differing outcomes that may be expected when courses with different characteristics are individualized. The variables in the regression equation (Table 5) indicated that individualization of a course containing a relatively large amount of memory content would result in more substantive time savings than would individualization of an otherwise similar course with less memory and more cognitive content.

To investigate this question, the number of minutes of memory content material (MEM) in the course represented in the standard sample was increased by one standard deviation, i.e., 72 minutes per lesson. In order to keep lesson lengths constant, a corresponding reduction of 72 minutes per lesson was made in the amount of cognitive content (COG). This represented a reduction of 0.49 standard deviations in the cognitive content.

The Time and Cost results for this high-memory-content course are given in Table 11 which employs the same format as Table 7. For purposes of comparison with the standard sample, data from Tables 7 and 11 are summarized in Table 12. As may be seen from Table 12, substantially greater time savings would be expected from individualization of a course with a higher percentage of memory content. While the predicted average course completion time for the standard sample course was 19.17 hours (down from 40 hours as taught by conventional methods), the predicted average course completion time for the high-memory-content course (also assuming a 40 hour conventional course baseline) was only 13.51 hours.

Again, it should be noted that while there are large differences in student pay costs between the two types of courses (29.5 percent), the difference in Total Course Cost is relatively small (8.1 percent).

TABLE 11

AIDE TEST RUN FOR HIGH-MEMORY/LOW-COGNITIVE-CONTENT COURSE

COURSE COMPLETION DATA (IN HOURS)

STUDENT VARIABLES		COURSE COMPLETION TIME (HRS.)
ASVADM	ASVMEC	
84	85	11.4
72	72	12.4
60	59	13.5
48	46	14.6
36	33	15.7

Average Course Completion Time Is 13.51 Hours

Average Time Saving Is 66.2 Percent

FUNCTIONAL FIVE YEAR COST SUMMARY

Courseware Procurement

Printed Media	\$ 136,600
Display Media	48,000
Software	13,100

Hardware Procurement

Media Hardware	13,400
Special Equipment	0
Overhead Hardware	- 300

Facility Construction 75,000

Pay and Allowances

Students	769,300
Instructors	1252,800
Curriculum Personnel	79,300
Hardware Maintenance Personnel	142,500
Facilities Maintenance Personnel	60,000
Training Admin. Personnel	289,500
Base Operating Support Personnel	205,300
Medical Personnel	43,100

PCS Costs

Students	7166,700
Instructors	19,200

Instructor Training

Factory Training of Initial Cadre	3,000
Education Training	40,700

Miscellaneous Operating Costs

Computer Service Charge	330,000
Hardware Replenishment/Repair	5,500
Miscellaneous Supplies	32,400

TOTAL COURSE COST \$10,725,100

TABLE 12
TIME AND COST COMPARISONS FOR STANDARD AND HIGH MEMORY/LOW COGNITIVE
CONTENT COURSES

SAMPLE DESCRIPTION	AVERAGE TIME		STUDENT PAY COST		TOTAL COURSE COST	
	Hours	% Change	\$*	% Change	\$*	% Change
Standard Sample with Mean Values on MEM, COG	19.17	0.0	1091.7	0.0	11675.6	0.0
Standard Sample with MEM increased 1 S.D., COG decreased 0.49 S.D.	13.51	-29.5	769.3	-29.5	10725.1	-8.1

* In Thousands of Dollars

5.2.3 Effect of Variation of Conventional Course Presentation Methods - One of the most striking aspects of the regression equation to predict first-attempt-lesson-time (Table 5) was the difference between the coefficients of two of the quantitative course content variables: Lecture/Discussion Minutes and Demonstration/Performance Minutes - Cognitive. According to these coefficients, each additional minute of Lecture/Discussion presentation in the conventional course would be expected to increase first attempt lesson time in the individualized course by only 0.12 minutes. In contrast, each additional minute of Demonstration/Performance-Cognitive presentation would be expected to increase first-attempt-lesson-time in the individualized course by 0.26 minutes. On the assumption that these values were approximately correct, a final comparison was made to illustrate the differing effects of individualizing two courses which differed on these dimensions.

For the purpose of this comparison, the number of minutes of Cognitive Demonstration Performance time (CDPMC) was increased by 0.75 standard deviations (48 minutes) per lesson. A corresponding reduction of 48 minutes per lesson in Lecture/Demonstration time (CLDM) amounted to a change of 0.49 standard deviations.

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The time and cost results for this high-demonstration/performance-method course are given in Table 13 which employs the same format as Table 7. For purposes of comparison with the standard sample, data from Tables 7 and 13 are summarized in Table 14. As may be seen from Table 14, no time savings would be expected from the individualization of a course which employed Demonstration/Performance methods for this very high proportion of the content. The predicted average course completion time for the individualized high-demonstration/performance-method course was 44.52 hours, an increase of 4.52 hours over the conventional course.

TABLE 13

AIDE TEST RUN FOR HIGH-DEMONSTRATION/PERFORMANCE-METHOD COURSE

COURSE COMPLETION DATA (IN HOURS)

STUDENT VARIABLES		COURSE COMPLETION TIME (HRS.)
ASVADM	ASVMEC	
84	85	42.4
72	72	43.4
60	59	44.5
48	46	45.6
36	33	46.7

Average Course Completion Time Is 44.52 Hours

Average Time Saving is -11.3 Percent

FUNCTIONAL FIVE YEAR COST SUMMARY

Courseware Procurement

Printed Media	\$ 137,800
Display Media	48,000
Software	13,100

Hardware Procurement

Media Hardware	51,400
Special Equipment	0
Overhead Hardware	12,800

Facility Construction 150,000

Pay and Allowances

Students	2531,600
Instructors	3751,700
Curriculum Personnel	79,300
Hardware Maintenance Personnel	463,600
Facilities Maintenance Personnel	115,500
Training Admin. Personnel	544,300
Base Operating Support Personnel	607,400
Medical Personnel	131,500

PCS Costs

Students	7154,300
Instructors	67,400

Instructor Training

Factory Training of Initial Cadre	3,000
Education Training	125,400

Miscellaneous Operating Costs

Computer Service Charges	410,000
Hardware Replenishment/Repair	17,500
Miscellaneous Supplies	95,600

TOTAL COURSE COST \$16,511,200

TABLE 14
TIME AND COST COMPARISONS FOR STANDARD AND HIGH-DEMONSTRATION/
PERFORMANCE-METHOD COURSES

SAMPLE DESCRIPTION	AVERAGE TIME		STUDENT PAY COST		TOTAL COURSE COST	
	Hours	% Change	\$*	% Change	\$*	% Change
Standard Sample with Mean Values on CDPMC, CLDM	19.17	0.0	1091.7	0.0	11675.6	0.0
Standard Sample with CDPMC increased .75 S.D. CLDM decreased .49 S.D.	44.52	132.2	2531.6	131.9	16511.2	41.4

* In Thousands of Dollars

5.3 DISCUSSION OF AIDE EXAMPLE RUN RESULTS

The three questions discussed above represent simple examples of how the AIDE cost model analysis program may be exercised, using differing student and lesson variable values, to investigate the expected cost savings resulting from individualizing different types of courses. Again, it should be emphasized that the data presented were not intended to be representative of the AIS courses from which the regression equation data base was derived. Neither was the intent to exploit fully the capabilities of the Rand MODCOM program from which the AIDE program was derived.

There are a number of general points which should be explicated. The various example runs indicate that direct student costs, pay and allowances, account for relatively little of the total course costs. For the Standard Sample (Table 7), student pay and allowances account for only 9.35 percent of the total. Although, as is discussed below, some of the cost figures provided are somewhat misleading, these values do illustrate the point that military technical training does have substantial fixed costs which are relatively insensitive to reductions in training time per se.

These additional costs were, however, inflated by two pre-analysis decisions reflected in the input data. First, the input data indicated that student relocation for training was to be treated as a permanent change of station (PCS). Given the predicted average course length of 19.17 hours (Standard Sample, Table 7), it would be more cost-effective to handle student relocation through temporary assignment - TDY. PCS costs for the standard sample were \$7,166,700 over the five year period; six and one-half times as much as student pay and allowances over the same period. If relocation for training had been handled by means of TDY assignment and if one assumed a six hour training day, this expense would have been reduced to approximately \$2,903,500. This figure still represents over two and one-half times the cost of student pay and allowances.

A second factor which increased predicted costs was the decision that the entry interval should be 30 class hours or once per week. Given that the average course completion time was predicted to be less than 20 hours, very few students would still be present in the course at the end of the week. While the average student load was computed to be 36.2, the actual number would range from a high of at least 64 students at the time of a class entry to a low of near zero just prior to the next class entry. This represents an extremely inefficient use of both personnel and facilities. Although such a test run was not made, it can be anticipated that a substantive cost reduction would result if the entry interval was reduced to six hours, allowing 12 to 13 new students to enter the course each day.

Although these two factors, permanent change of station and once per week entry, did inflate the estimated costs relative to student pay and allowances, the conclusions drawn concerning the relative costs of the various samples run, i.e., above and below average student ability levels, high-memory/low-cognitive content, etc., remain valid. Even with TDY assignment and daily course entry, student pay and allowances would still contribute only a fairly small proportion to the total course costs.

6.0 CONCLUSIONS AND RECOMMENDATIONS

This study represents the first effort to employ data from an operational environment in an attempt to relate variables such as course content, instructional and system design considerations, and student characteristics to completion time in a self-paced course and to the cost of developing, implementing, and maintaining such a course. The study has, we believe, demonstrated that a viable time savings and cost model can be developed given a sufficient data base from which to draw information. The generality and precision of such a model is, however, dependent on the depth to which the instructional system from which the data are derived can be fully and explicitly described. Analogously, the utility of the model for a given application will depend on the accuracy with which the course being considered for self-pacing is described. In addition to a description of the course content, the model requires a number of assumptions concerning instructional and system design variables and the characteristics of the students to be enrolled in the course. The predictive accuracy of the model will, of course, always be limited by the validity of these assumptions.

As was stated above, the authors believe that the current study has demonstrated the feasibility of developing time savings and cost models which have practical utility. It must be recognized, however, that there is a number of limitations both to the specific model developed here and to future efforts which employ this work as a starting point. Each of the three major components of the overall effort, the descriptive model, the predictive model, and the cost model, will be discussed with respect to these limitations as well as with respect to their positive aspects.

The descriptive model of computer-based training systems can be viewed as serving as a framework for the predictive model and a guide to its development. The utility of the predictive model will always be limited by the generality and completeness of the descriptive model. While the descriptive model employed in this study would appear to be appropriate, it must be recognized that its adequacy was not actually tested by the current effort, since the predictive model developed directly addressed only a small portion of the total descriptive model.

It is suggested, however, that the general characteristics of the descriptive model proposed are appropriate to an effort of this type, i.e., description of an instructional system in terms of a number of time-consuming components and the probabilities associated with a limited number of decision points. Our experience with predicting a single time component (first-attempt-lesson-time) indicates that it is feasible to develop miniature predictive models for the remaining components, given the availability of reasonably accurate data.

The one exception to this generally optimistic view must be noted - prediction of the time component entitled Cumulative Administrative Overhead. The quantity of administrative overhead would appear to be heavily dependent on local course policies. While this assumption needs to be examined in greater detail, it would appear that the time attributable to this component may be too specific to local situations to be estimated with any degree of accuracy on the basis of available data.

A second problem area lies in estimating the probabilities associated with the pass/fail decisions following the various lesson and unit tests. As was discussed in Paragraph 4.2.1 of this report, these decisions again appear to be highly dependent on local course policies. Consequently, predictions based on data from any given course or set of courses will be biased by the policies in effect in those courses and fail to generalize to a new course. The best solution to this problem may be to establish tolerable failure rates as part of the instructional system design specifications and assume that instructional materials and procedures will be developed such that student performance will meet these specifications.

It should be noted that the descriptive model can be viewed as consisting of several nested loops: the time required to complete the major instructional unit; the time required to complete a given lesson; and the time required by the individual components within the lesson completion loop. As a result, the model has the interesting attribute that it is not necessary that all of the individual components be modeled explicitly. To the extent that individual components are modeled accurately, the overall estimate of instructional unit completion time becomes more responsive to variations in content, student characteristics, and instructional method. The model still has utility, however, if only gross estimates are made of the total time required by the set of components which were not modeled. The

initial effort represented by this study exemplifies the extreme case of such an approach. The single component, first-attempt-lesson-time, was modeled as accurately as possible under the circumstances. The cumulative time attributable to the remaining components was then estimated as a function of first-attempt-lesson-time. The final result, although not as accurate as might be desired, does provide a useful estimate of the total time required to complete an arbitrary instructional unit. Detailed modeling of any additional component will increase the accuracy of the overall estimate. Thus, further refinement of the model can proceed step-by-step as more data become available.

Discussion of the predictive model brings us to the actual mechanics involved in estimating the time required for an individual student to complete an arbitrary instructional unit. It is of some interest to compare the methodology and results of the current study with the work reported by Wagner, Behringer and Pattie (1973) in predicting individualized course completion. The major differences between the two efforts are a function of their differing objectives. While Wagner, et al, were interested in predicting the time required to complete a particular self-paced course, the intent of the work reported here was to predict the time required to complete an arbitrary instructional unit, given a limited set of characteristics of that unit. Specifically, whereas all of the students in the Wagner, et al, study worked through the same set of materials, the criterion variable in the current study represented the time to complete each of 66 different instructional units. The fact that the multiple correlation coefficient of .6283 obtained here compares favorably with the correlations of .65 to .75 reported by Wagner, et al, indicates that the lesson descriptor variables employed in the current study did accurately represent the characteristics of the various lessons. While Wagner, et al, were able to obtain substantially higher correlations (.85 to .87) through the use of within-course measures, such measures would not have been appropriate to the objectives of the current study. Wagner, et al, also found that the measurement of individual difference characteristics through the use of course content-related instruments was preferable to the use of the standard military battery. The current study found that the use of available preassessment measures did not appreciably increase the accuracy of prediction in the presence of ASVAB scores, but the results might have been different had the preassessment battery contained more content-specific tasks. Again, however, such content-specific measures would have very limited utility given the objectives of the current work.

The regression analysis approach employed in this study would also appear to be appropriate for estimating the time required for many of the remaining components of the Descriptive Model such as Remedial Study Time on Lesson i and the time required for the various diagnostic and credentiaing tests. In other cases, such as estimating the time consumed in obtaining resources and test scoring, an alternate approach based on queuing theory might well be more appropriate.

It should be noted that the current study did not fully investigate all aspects of the regression model approach. Only simple, linear predictors were employed. There is reason to believe that accuracy of prediction could have been improved if the effects of nonlinear transformations of the predictor variables had been investigated. For example, it is reasonable to expect that the relationship between first-attempt-lesson-time and student individual differences could be better represented by a curvilinear relationship than by a simple linear relationship. The failure to investigate interactions among the various predictor variables represents an even more serious limitation. The final regression model does not include any terms which are products of two or more predictor variables. As a result, for example, the final regression model contains the assumption that while two students of differing ability levels will complete a given lesson in differing amounts of time, the difference between their two completion times will be independent of the amount of lesson content. That is, if Student A requires ten more minutes than does Student B to complete a particular lesson, the model implies that Student A will also require only ten more minutes than Student B to complete a second lesson containing twice as much content as the first lesson. The incongruity would be resolved if the predictor set contained one or more variables which were the multiplicative products of appropriate student ability and course content measures. The same line of argument implies the desirability of including product terms which incorporate instructional design variables such as the number of self-check items.

The effort required for adequate investigation of potential transformations and product terms was simply not feasible within the temporal and fiscal constraints of the current study. Investigation of at least interaction terms should certainly be given consideration in any work directed at refining the predictive model.

The major limitations of the current study can be traced directly to the lack of a sufficiently broad and reliable data base. To a great extent, any future efforts

in this area will be limited by these same constraints. In general, data acquisition problems fall into four broad categories: self-paced student performance data; base-line course content descriptions; the variability of examples of instructional methods; and the distribution of observations across variations in course content, instructional methods, and student individual difference characteristics.

At the time the data collection effort for the current study was being conducted, the AIS was in a relatively rudimentary stage of development, and the only reliable lesson level time data available were first-attempt-lesson-times. Therefore, the predictive model was limited in explicit prediction to this single component. Since that time, further development of the AIS has allowed collection of reliable, remedial study times and lesson completion times. Were the study to be repeated now, a predictive model could be developed which addressed several components of the instructional process. Obviously, future efforts will be more fruitful if they are conducted in the context of an instructional system with a fully developed data collection and recording component.

While there are advantages to conducting future modeling efforts in the context of an established system, there is a definite disadvantage in attempting to model courses which have been conducted under the auspices of such a system for any length of time. The modeling approach employed in this study assumes the existence of course planning documents which pertain to the course as it was taught in a conventional, group-paced mode. Since technical training courses do change, there is, with time, less and less overlap between the current content of the self-paced course and its content when it was taught in the conventional mode. It will be recalled that none of the nine blocks of instruction sampled in this study contained exactly the same content as they did in the earlier, conventional course. If the study were to be repeated now, there would be even less overlap. Proposed changes to the Inventory Management course indicate that within a year almost none of the content in the original, group-paced course will still be taught. It is therefore suggested that any future efforts at model refinement be conducted in the context of an established system to which new courses are being added.

There is undoubtedly a tendency for a given instructional system to shape the instructional methods employed in that system. One tends to find relatively little variability in method across lessons. Thus, the effect of advanced organizers such

as the presentation of lesson objectives could not be evaluated in the current study since all of the lessons sampled contained such objectives. Similarly, the numbers of embedded questions and lesson test items were found to be so highly correlated with the amount of lesson content that it was necessary to exclude them from the predictor set. Relatively little of their variability was independent of lesson length. While the post-instructional organizer, Number of Self-Check Items, was retained in the predictor set, the typical number of such items per lesson was so small that one should be hesitant in using the regression equation information to evaluate the utility of such organizers. It would be desirable to sample a much wider variety of values of course content variables in any future efforts at model refinement. The current study's limitation to two courses makes it difficult to disentangle the effects due to differences in course content from those due to unmeasured, course-specific factors. Finally, it would be highly desirable if future work could include examination of a variety of alternative instructional media, including computer-assisted instruction.

The final data problem area concerns the intercorrelation of predictor variables. If it were possible to manipulate directly the variables of interest, one would impose experimental controls to hold other conditions constant while varying one, or at most a limited set, of variables. Since this was not possible, the current study employed a regression analysis approach in an attempt to examine statistically the effects of individual variables. The regression approach is limited, however, in that the confounding effects due to the intercorrelations among variables cannot be controlled. For example, if a particular instructional method was always employed for teaching a particular class of content, and never employed for teaching other categories of content, its effect could never be evaluated. Nor could one determine the expected time savings due to self-pacing with other instructional methods for that class of content. Other, less extreme examples can also present problems. Within the current AIS system, the more expensive audio-visual media are generally employed only for those lessons which experience has proven to be particularly difficult for students when the material was presented in the less expensive, programmed text format. Thus, a regression equation predicting lesson completion time which incorporated a presentation medium variable would, under these circumstances, tend to misrepresent the utility of audio-visual presentation as compared to programmed text because data on the audio-visual mode were not sampled across the full range of

lesson content. It is anticipated that problems of this type will continue to be a major limitation to further development of the predictive model.

The computer cost analysis model developed in this study incorporates an estimate of students' course completion time based on relevant course content, instructional design, and student characteristic variables. It thus increases the scope of Rand's MODIA cost model by basing course completion times on predicted values from a regression equation derived from actual data from an operational environment. The flexibility of input preparation allows the model to be used for both general and detailed levels of analysis.

The cost figures produced by the program are only as good as the accuracy of the course description provided and the similarity of the course to be modeled to the AIS courses from which data were sampled in this study. A further limitation of the cost analysis program is that only mean cost values are produced even though considerable variability is associated with the predicted course completion times. Further work on the AIDE cost model could improve its usefulness by computing the variances associated with the final course cost. The inclusion of variances would allow analysis of variance and linear model comparisons to be made on the costs of alternative approaches. As the model now stands, exercising it with respect to questions related to course content, instructional design, and student characteristics produces cost figures which can only be compared in terms of percentage of change without any measure of the significance of the cost differences.

In summary, the current study has provided three products which can facilitate the investigation of cost savings due to the individualization of military training. The Descriptive Model of Computer-Based Training Systems will, hopefully, provide a context within which to investigate the various components of such systems. The Predictive Model has explored a methodology which, with minor variations, can be developed to predict timesavings due to individualization accurately in a variety of training environments. As instructional systems such as the AIS become established, a broad, reliable data base will become available which can be used to support a systematic, empirical approach to the selection of additional courses for individualization. Finally, the AIDE Cost Model has extended the Rand MODCOM program to incorporate the variable course completion times characteristic of computer-based training systems.

One final comment would appear to be appropriate. As was discussed in Section 5.3 of this report, Discussion of AIDE Example Run Results, those training expenses which are directly attributable to students and which are sensitive to variations in course completion time, (i.e., student pay and allowances) form a relatively small proportion of total course costs. If substantive cost savings are to be realized from the individualization of instruction, the total training system, including support personnel and facilities, must be critically examined. For example, the emphasis to date has been on shortening course completion time while holding the number of instructional personnel constant. It may well be more cost effective to allow somewhat longer course completion times while reducing the student/instructor ratio. The coordination of student arrivals and departures from the training base is at least as important as is the efficient use of the student's time in the classroom. Personnel whose duties are only tangentially related to training account for a sizeable portion of a training base's budget. Reducing the length of one or two small enrollment courses by 20 or even 30 percent will not appreciably decrease the number of students on base and will not, consequently, allow any reductions in the number of these support personnel. If, on the other hand, a substantial proportion of the training on a given base were individualized and the expected time savings realized, a number of indirect costs could be reduced. Referring to the functional cost items shown for the standard sample in Table 7, one would expect broad scale reductions in course times to impact the following items: Facility Construction; Instructor Pay and Allowances; Facilities Maintenance Personnel; Training Administration Personnel; Base Operating Support Personnel; Medical Personnel, PCS costs for instructors; and Instructor Education Training. These items account for an additional 21 percent of the total course costs, and reductions in these areas would almost certainly result in substantive savings. It may well be the case that the full potential of computer-based training systems for cost reduction will only be realized when they have become the norm rather than the exception in military training.

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APPENDIX A

AID FOR INSTRUCTIONAL DEVELOPMENT AND EVALUATION

GENERAL

This appendix describes some technical aspects of the AIDE computer cost analysis program. Appendix B gives a complete FORTRAN listing of the AIDE program. Appendix A includes the following:

- o Computer Program Overview
- o Differences Between AIDE and MODCOM Data Inputs
- o Using a different Regression Equation
- o General Comments About the FORTRAN Program
- o Input Data Preparation
- o Computer Program Output Description.

Computer Program Overview

The computer program was called Aid for Instructional Development and Evaluation (AIDE). The development of the AIDE computer program was facilitated by splitting the program into the following major modules:

Input Module: Read and check input data. Input data will include lesson descriptors, student descriptors, instructor data, courseware data, instructional resources data, physical facilities data, and CMI system data. A complete list of the input data is given in a subsequent section of this Appendix.

Course Duration Module: Use the regression model and overhead factor developed in Section 4.0 to compute the average course duration and the percentage time-saving.

Student Flow Module: Use the average time-to-complete the course to compute the average enrollment level in the course.

Resources and Personnel Module: Based on the average enrollment in the course and other user supplied course data, find the courseware development and maintenance manhours, student and instructor staff manhours, instructional hardware and other resources procurement quantities and maintenance manhours, and computer system hardware quantities. In determining these quantities, allowance is made for fluctuations in the enrollment level.

Cost Accumulation Module: Combine personnel and resource quantities with unit costs to arrive at development, initial investment, and annual operations and maintenance costs to operate the course over a period of five years.

Output Module: Write intermediate and final results.

Prior to the start of programming the model, our literature survey and contacts with instructional system developers revealed that the Rand Corporation had been developing an instructional model called MODIA (Methods of Designing Instructional Alternatives). The MODIA Cost Model (MODCOM) was well developed and performed several of the functions needed in the AIDE Model. Specifically, these are:

- o Several input routines for courseware, hardware and personnel
- o A routine to generate student manyears, given the average time to complete the course

- o Estimation of training administration, base operating support, and medical support personnel
- o A cost accumulation subroutine
- o Routines to summarize input data, intermediate results, and final results.

In view of these similarities, we requested and received a copy of the MODCOM computer program from the Rand Corporation.

The programming efforts were then directed at writing the subroutines to compute the course duration and estimate resource quantities and modifying the MODCOM program so as to integrate it with these subroutines. A listing of the computer program is given in Appendix B. The inputs to be supplied by the user and the outputs of the computer program, are described in the following paragraphs.

Differences Between AIDE and MODCOM Data Inputs

The first 15 data card types of AIDE are similar to those of MODCOM, but AIDE adds a 16th data card type for lesson descriptors. Specific format differences exist in AIDE for the following card types: 3, 9, 10 and 12. AIDE always uses the calculation option where MODCOM gives a choice of calculation or throughput.

Using a Different Regression Equation

A regression equation of up to three student variables and up to eleven lesson variables can be entered by changing the DATA statement values in lines 91 through 98 of the program AIDE with no other reprogramming necessary. NSVAR and LDES are the number of student and lesson variables respectively. TVAL(11) is the vector of maximum values for the lesson variables. Regression equations of a different combination of variables will require additional changes in the FORTRAN program in PROGRAM AIDE and in subroutines (overlays) READS, READW, AIDEA and AIDEB. Specifically, the common statement of AIDE1A and AIDE2 will be involved as well as read and write formats in PROGRAM AIDE and subroutines READS, READW, AIDEA and AIDEB.

General Comments About the FORTRAN Program

The AIDE FORTRAN Program was developed on the CDC Cyber 73-16 computer at AIS, Lowry Air Force Base, Colorado. The program is presently overlaid to fit within a 130K core memory limit. The overlay will need to be re-setup by a programmer for the local computer facility. The flowcharts and other detailed documentation accompanying the MODCOM FORTRAN program (Hess and Kantar, 1976) apply to AIDE as well, with the exception that AIDE adds three subroutines (READW, AIDEA, and AIDEB) and deletes one subroutine (OUT5).

Input Data Preparation

This section describes the inputs to the AIDE computer program. The general form and style of the inputs are derived from the Rand MODCOM program which played a large part in the development of our AIDE model. The description of the Rand model variables is taken from a report provided to us prior to publication by Rand.

A large amount of data can be entered into the program. Only data relating to lessons (regression model variables), student variable scores, and class entry interval are required. Any other data omitted will be treated either as if it were zero or assigned a default value.

Data are input to the model on cards. Sixteen types of card formats are used, as listed in Table 11. The detailed form of each card is described below. The following general comments apply to all cards:

Format Identifier: All cards must have the format type punched in columns 1 and 2.

Blanks: Unless otherwise specified, all blanks in numeric fields are read as zeros.

Mandatory Inputs: The variables which must be assigned non-zero inputs are: "entry interval (in hours)," on card format 2; student variables scores on card 3; and at least one set of lesson descriptors (card 16). Failure to enter a non-zero value for these variables will result in the printing of an error message and program termination. Format type 99 is used to signify the end of the input data; one card of this type must be present. Failure to enter this card will result in a FORTRAN error message and program termination.

TABLE 11
DATA CARD TYPES

FORMAT NUMBER	CARD TYPES
1	Title Card
2	General Course Factors
3	Student Inputs
4	Instructor Inputs
5	Courseware Inputs
6	Curriculum Manpower Inputs
7	Hardware Procurement Inputs
8	Hardware Maintenance Manpower Inputs
9	Facility Procurement Inputs
10	Facility Maintenance Manpower Inputs
11	Training Administrative, Base Operating Support, and Medical Manpower Inputs
12	Computer Management System Inputs
13	Optional Officer/Airman/Civilian Distribution Overrides
14	Optional Miscellaneous Overrides
15	Optional Pay and Allowance Overrides
16	Lesson Descriptors
99	Termination Card

Card Limit: In order to preserve core memory, it was necessary to put limits on the number of cards of each format type which can be entered for a single run of the AIDE Model. This limit is indicated in the description of each card type. Cards in excess of that limit are deleted from further processing.

Card Deletions: Throughout this section, mention is made of card deletions which will occur if certain input conditions are violated (e.g., input not within acceptable range, and illegal input combinations). All such card deletions will be listed as part of the output with an appropriate error message.

Decimal Points: All input data are entered as real (floating-point) numbers. The implied decimal point location is at the right end of each field unless otherwise specified. However, a punched decimal point always overrides an implied decimal point location.

Format 1: Title Card Card Limit = 1 - This card is used to identify AIDE runs. The title, to be entered in columns 3 through 80, may contain between 1 and 78 alphanumeric characters. If this card is excluded, then the default title, AIDE model, is used.

Format 2: General Course Factors Card Limit = 1 - This card contains inputs describing washouts, instructor training costs, and the old course duration.

Columns 3-7 (5 column numeric field): Old course duration (in hours). This number, as described in Section 4.2, is the number of hours of instruction presented in the old course. If a value is not entered, the new course duration will be computed, but not time savings.

Columns 8-11 (4 column numeric field): Washout rate (%): The ratio of the number of washouts to the total number of entrants times 100.

Columns 12-15 (4 column numeric field): Entry interval (in hours): The average length of time separating entry classes.

Columns 16-19 (4 column numeric field): Number of months instructors on board in year 0: The number of months the initial instructor cadre will spend preparing for the subject course in year 0. This value, which must be supplied by the planner, should include time required for special factory training and education training as well as time necessary for curriculum development.

Columns 20-24 (5 column numeric field): Cost of initial factory training (in dollars): The total cost, less student pay and allowances, of providing the initial instructor cadre with specialized equipment or system training necessary for course development and conduct. This initial specialized training is usually accomplished at a private contractor's facility. Subsequent specialized training of instructors is usually provided informally by the existing instructor nucleus. This cost should include travel per diem, transportation expenses, destination per diem, and attendance fees (or contract costs), as applicable. The pay and allowances of the initial instructor cadre while in student status will be accounted for elsewhere.

Columns 25-29 (5 column numeric field): Cost of instructor education training (\$): The cost of the six-week instructor prerequisite course on education principles.

Format 3: Student Inputs Card Limit = 75 - This card contains inputs relating to the number and type of student entrants, and values of the three student characteristics variables (ASVADM, ASVMEC, SEX).

Breakdown of Student Entrants - The course planner must determine the breakdown of total annual student entrants by personnel type (Active Duty Force Pipeline, Active Duty Force Lateral/Upgrade, Guard/Reserve Pipeline, Guard/Reserve Lateral/Upgrade, Other DoD Pipeline, Other DoD Lateral/Upgrade, Non-DoD), personnel designator (officer, airman, civilian), and paygrade. Typical paygrades for Air Force pipeline and lateral/upgrade students are:

<u>Student Type</u>	<u>Officer</u>	<u>Airman</u>
Pipeline	0 - 1	E - 1
Lateral or Upgrade	0 - 2 thru 0 - 4	E - 3 thru E - 5

Columns 3-4 (2 column numeric field): Personnel Type: Numeric personnel type code as follows:

- 01 = Active Duty Force Pipeline Student
- 02 = Active Duty Force Lateral Upgrade
- 03 = Guard/Reserve Pipeline Student
- 04 = Guard/Reserve Lateral Upgrade Student
- 05 = Other DoD (Army, Navy) Pipeline Student
- 06 = Other DoD (Army, Navy) Lateral Upgrade Student
- 07 = Non-DoD (MAP) Student

Use of a code outside the range 1 through 7 will result in the deletion of the card.

Columns 5-6 (2 column numeric field): Personnel Designator: Numeric personnel designator code as follows:

- 1 = Officer
- 2 = Airman
- 3 = Civilian-GS (General Schedule)
- 4 = Civilian-WB (Wage Board)
- 5 = Non-DoD

Use of a code outside the range 1 through 5 will result in the deletion of that card. Additionally, card deletion will occur if personnel designator 5 is used in combination with any personnel type other than 7.

Columns 7-8 (2 column numeric field): Pay Grade: Standard U.S. Government numeric pay grade codes. The code entered in these columns must be within the range of permissible paygrades for the specified personnel designator or else the card will be deleted. A duplicate personnel type/personnel designator/paygrade combination will also cause a card to be deleted. The number of unique paygrades entered for a given personnel type/personnel designator combination will depend on the required level of accuracy and the ambition of the user: each paygrade requires a separate card entry. ATC generally uses a single paygrade (the modal) for each personnel type/personnel designator combination. In order to reduce the planner's input requirements, pay and allowance factors for each paygrade have been stored as part of the model.

Civilian (Personnel Designator = 3 and 4)

<u>Paygrade</u>	<u>Stored P&A Factor (\$) for GS Civilians (3)</u>	<u>Stored P&A Factor (\$) for WB Civilians (4)</u>
18	39,060	
17	39,060	
16	39,060	
15	35,823	
14	30,377	15,157
13	28,053	14,773
12	22,285	13,845
11	18,935	13,373
10	17,041	12,758
9	15,717	12,127
8	14,254	11,471
7	13,828	11,077
6	11,782	10,527
5	10,483	9,587
4	9,266	9,214
3	7,953	8,896
2	6,447	8,491
1	5,651	7,912
Blank or 0	12,599	11,464
(Overall Average)		

Additionally, a dummy pay and allowance schedule has been set up for non-DoD students with 20 possible paygrades. However, because of the wide range of possible pay rates, typical values could not be established; and consequently, the stored values were set equal to zero. If the planner feels that non-DoD student pay and allowances are relevant to a particular costing exercise, then the pay factor override option should be employed to introduce the appropriate pay rate.

Columns 9-11 (3 column numeric field): The score of this type of student on the ASVADM test (0-100).

Columns 12-14 (3 column numeric field): The score of this type of student on the ASVMEC test (0-100).

Columns 15-17 (3 column numeric field): The ratio of male students to the sum of male and female students (0-1.0).

Columns 18-37 (five 4-column fields): Number of student entrants of this type in years 1-5.

Format 4: Instructor Inputs Card Limit = 25 - This card contains inputs pertaining to the size, turnover, and student loading of the instructor force.

Breakdown of Instructor Force - The course planner must determine the breakdown of total instructor force by personnel type (Air Force, Other DoD), personnel designator (officer, airman, civilian) and paygrade, and student load. Typical paygrades for each instructor type are provided in Table 12.

TABLE 12
TYPICAL INSTRUCTOR PAYGRADES

Instructor Type	Officer	Airman	Civilian
Academic, remedial or special requirements instructor	0 - 3	3 - 5	GS - 9
Evaluators and Supervisors	0 - 4	E - 6, E - 7	GS - 11

Columns 3-4 (2 column numeric field): Personnel Type: Numeric personnel type code as follows:

8 = Air Force Instructor

9 = Other DoD (Army, Navy) Instructor

Use of a code other than 8 or 9 will result in the deletion of that card.

Columns 5-6 (2 column numeric field): Personnel Designator: Numeric personnel designator code as follows:

- 1 = Officer
- 2 = Airman
- 3 = Civilian - GS
- 4 = Civilian - WB

Use of a code outside the range 1 through 4 will result in the deletion of that card.

Columns 7-8 (2 column numeric field): Paygrade: Standard U.S. Government numeric paygrade codes. The codes and stored pay factors are the same as those described for input format 3. As before, the code entered in these columns must be within the range of permissible paygrades for the specific personnel designator or else the card will be deleted. A duplicate personnel type/personnel designator/paygrade combination will also cause a card to be deleted.

Columns 9-11 (3 column numeric field): Turnover rate (%): The percentage of instructors who will be replaced each year or the reciprocal of the average instructor's tour length in years times 100.

Columns 12-16 (5 column numeric field): Size of initial instructor cadre in year 0; the number of instructors (not many years) brought onboard in year 0 for curriculum development and any required factory training.

Columns 17-19 (3 column numeric field): Students per Instructor: The number of students that can be instructed or counseled by an instructor of this type.

Format 5: Courseware Procurement Inputs Card Limit = 75 - The model recognizes four classes of courseware: (1) printed media such as textbooks and workbooks which are intended for both students and instructors; (2) printed media such as lesson and evaluation guides which are intended only for instructors; (3) display media such as films, slides, and charts; and (4) software such as teaching machine programs.

Four separate costs are estimated: (1) The initial cost of producing the master from which all subsequent copies will be made; (2) the cost of reproducing and packaging the required number of copies; (3) the annual cost of revision due to change in course content; and (4) the annual cost of replacement due to loss, damage, or

normal aging. The cost of courseware development, such as script writing and editing, is accounted for within curriculum manpower pay and allowances.

Columns 3-4 (2 column numeric field): Courseware ID Number: Unique number for each courseware type in range 1 through 99. A card will be deleted if its ID number duplicates that of another card or if its ID number falls outside the prescribed range.

Column 5 (1 column numeric field): Class: Numeric courseware class code as follows:

- 1 = Printed media for students and instructors (texts, workbook)
- 2 = Printed media for instructors only (lesson and evaluation guide)
- 3 = Display media (films, slides)
- 4 = Software (teaching machine programs)

Use of a code outside the range 1 through 4 will result in the deletion of that card.

Columns 6-27 (22 column alphanumeric field): Name of courseware: User-selected name for identifying each courseware type.

Columns 28-31 (4 column alphanumeric field): Name of courseware copies: User-selected name for identifying the unit denominator (book, reel, set) of each courseware type.

Columns 32-37 (6 column alphanumeric field): Name of courseware measure: User-selected name for identifying the unit of measure (pages, minutes, slides, etc.) for each courseware type.

Columns 38-41 (4 column numeric field): Total number of courseware measure per copy: The number of pages, slides, or minutes, etc., per unit of courseware.

Columns 42-46 (5 column numeric field): Initial preparation cost per courseware measure (\$): The cost of producing a single measure of master courseware. Some typical values are provided in Table 13.

Columns 47-50 (4 column numeric field): Copy cost per courseware measure (\$): The cost of copying a single measure of master courseware. Typical values are again provided in Table 13.

Columns 51-54 (4 column numeric field): Packaging cost per unit: The cost of cassettes, reels, trays, etc., per unit of courseware. Some typical values are as follows:

Sound on Slide Tray	\$30.00
Slide Tray - 40 slides, straight	2.50
Audiotape Cassette	2.00
Video Cassette Tape (30 minutes)	18.00
Video Cassette Tape (60 minutes)	25.00
Loose-leaf Binder (3-12", Telescoping Poles)	3.00

TABLE 13
TYPICAL COURSEWARE PROCUREMENT COSTS

	Courseware Measure	Initial Preparation Cost/ Courseware Measure Dollars	Copy Cost/ Courseware Measure Dollars
Printed Text	Pages	\$1.50 - \$4.50	.01
Sound Slide Set (Color)	Slides	50 - 1.00	.08
35mm Color Slide (Text)	Slides	4.50 - 9.00	.08
35mm Color Slide (Illustration)	Slides	7.50 - 25.00	.08
8mm Animated Sequence	Seconds	.40 - .85	-
Video Tape	Minutes	1.00 - 2.00	-

Columns 55-57 (3 column numeric field): Annual revision rate (%): The percentage of each courseware type's actual presentation minutes which can be expected to be revised annually due to changes in course content. These changes in course content could be caused by such things as modifications to mission equipment, a required upgrading of student capabilities, or an effort to improve the utilization of course resources. The model assumes that after the necessary revisions are made to the master, sufficient copies will be made of the revised portions (only) and integrated into the existing copies.

Columns 58-60 (3 column numeric field): Annual replacement rate (%): The percentage of each courseware type's units which will need to be replaced annually due to damage or normal aging.

Columns 61-64 (4 column numeric field): The number of lessons in the course utilizing this courseware. Courseware description need not limit it to only one lesson. For instance, several programmed text lessons could be grouped into one data entry. If blank, value is set equal to one.

Columns 65-67 (3 column numeric field): Number of simultaneous users per copy. This entry is used for courseware that is used simultaneously by more than one student, as in a four-man AV presentation. If blank, value is set equal to one.

Format 6: Curriculum Manpower Inputs Card Limit = 75 - Curriculum personnel determine training requirements and develop course written material. Normally, attached to the Curriculum Unit of a training department, these personnel share the task of courseware development with the course's instructors.

Columns 3-4 (2 column numeric field): Courseware ID number: The number used to identify the same courseware type in input format 5. A format 6 card will be deleted if its ID number does not have a match on a format 5 card, or if its ID number duplicates that of another format 6 card.

Columns 5-9 (5 column numeric field): Number of course hours: The number of course hours taken up by a given courseware type. This number should be coordinated with the number of lessons specified on card type 5 for this type of material.

Columns 10-14 (5 column numeric field): Number of curriculum manhours per course hour: The number of initial development curriculum manhours required for each course hour. Generally speaking, this number is a function of the teaching agent and the teaching format and is independent of the courseware type. Typical values are provided in Table 14.

Columns 15-47 (3 column numeric field): Percentage accomplished by instructors: The percentage of curriculum development done by the instructors rather than curriculum personnel.

Format 7: Hardware Procurement Inputs Card Limit = 75 - The model estimates four types of hardware costs: (1) the cost of purchasing the incremental number of units required each year, including initial replacement part stocks; (2) credits for any surplus items returned to the Stock Fund; (3) the annual cost of replacing those

TABLE 14
INITIAL COURSEWARE DEVELOPMENT
MANHOURS PER CONVENTIONAL COURSE HOUR

Presentation Media	Development* Manhours per Hour
Programmed Text	50 - 70
Audio Visual	80 - 100
Computer Assisted Instruction	100 - 300
*If new material is being written, without benefit of notes from the old course, these numbers should be increased by about 40%.	

units worn out during the year; and (4) the annual cost of miscellaneous repair parts.

Columns 3-4 (2 column numeric field): Hardware ID number: Unique number for each hardware type in range 1 through 99. A card will be deleted if its ID number duplicates that of another card if its ID number falls outside the prescribed range.

Column 5 (1 column numeric field): Class: Numeric hardware class code as follows:

- 1 = media hardware (slide projectors, reel-to-reel projectors, tape recorders, teaching machines)
- 2 = special equipment (trainers, bailed aircraft)
- 3 = overhead hardware (chairs, desks)

Use of a code outside the range 1 through 3 will result in the deletion of that card.

Columns 6-35 (30 column alphanumeric field): Name of hardware type: User-selected name for identifying each hardware type.

Columns 36-39 (4 column numeric field): The number of units of a given hardware type which are available to a course at its inception, at zero cost.

Columns 40-47 (8 column numeric field): Procurement cost per unit (\$). Normally, an AF planner will consult his own service's supply manual to determine hardware unit costs.

Column 48 (1 column numeric field): Credit Option: Option to obtain credit for surplus equipment returned to Stock Fund (yes = 1; no = 0 or blank). The planner may obtain credit for surplus equipment returned to the Stock Fund provided both the following conditions are met:

- a. The unit cost does not exceed \$1,000.
- b. A demand exists elsewhere in the AF for the returned items.

The option should not be exercised if either the unit cost exceeds \$1,000 or if other AF demand does not exist. In fact, if the planner enters a "1" for an item costing more than \$1,000, then the model automatically resets the option designator value to "0." The planner should also enter a zero if any surpluses generated in a given year are to be retained for increased demands in subsequent years. The amount of the credit is 60% of the original purchase price, the other 40% assumed to go into rehabilitation action so that the equipment may again be sold at the full purchase price.

Columns 49-51 (3 column numeric field): Annual attrition rate (%): The percentage of hardware units which will need to be replaced each year. This value can be approximated by multiplying the reciprocal of the estimated average life (in years) by 100.

Columns 52-57 (6 column numeric field): Miscellaneous repair part cost per unit per year (\$): The annual cost of purchasing repair parts for a single unit. In the absence of better data, a value in the range of 6 to 10% of the unit procurement cost should be used.

Columns 58-61 (4 column numeric field): Number of lessons using this type of hardware. More than one lesson may utilize the same type of hardware (such as an AV projector); this item allows the planner to specify this fact.

Columns 62-64 (3 column numeric field): The number of students who may simultaneously use hardware item. This is the number of students who are studying the same lesson that may simultaneously use this hardware device.

Format 8: Hardware Maintenance Manpower Inputs Card Limit = 75 - Hardware maintenance personnel are responsible for the preventive and corrective maintenance of course hardware. Media hardware maintenance is generally the responsibility of the Training Services Division (school-level), while all other types of hardware are

usually serviced by the base Maintenance and Supply Group or a specialized maintenance squadron.

Columns 3-4 (2 column numeric field): Hardware ID number: The number used to identify the same hardware type in input format 7. A format 8 card will be deleted if its ID number does not have a match on a format 7 card or if its ID number duplicates that of another format 8 card.

Columns 5-10 (6 column numeric field): Number of failures per hour of use: The average number of times a particular type of equipment can be expected to fail for each hour of use.

Columns 11-15 (5 column numeric field): Average time to repair per failure (in hours). This value should include only that portion of downtime in which maintenance personnel are actively pursuing the repair activity.

Format 9: Facility Procurement Inputs Card Limit = 25 - This card contains inputs relating to the modification and construction of course facilities.

Columns 3-4 (2 column numeric field): Facility ID number: Unique number for each facility type in range 1 through 99. A card will be deleted if its ID number duplicates that of another card or falls outside the prescribed range.

Columns 5-34 (30 column alphanumeric field): Name of facility type: User-selected name for identifying each facility type.

Columns 35-38 (4 column numeric field): Units available "as is" at start of first year: The number of units of a given facility type which are available to a course at its inception at zero cost.

Columns 39-45 (7 column numeric field): Construction cost per unit (\$): The cost of constructing or modifying a single facility unit.

NOTE: If unit requirements for a given facility type are assumed to be available at zero cost for all years under study, then the user should enter a unit construction cost of zero.

Columns 46-49 (4 column numeric field): The number of students who can simultaneously use the facility. An example is the number of students who can simultaneously use a laboratory.

Format 10: Facility Manpower Inputs Card Limit = 25 - Facility maintenance personnel are responsible for the maintenance and repair (including custodial service) of course facilities.

Columns 3-4 (2 column numeric field): Facility ID number: The number used to identify the same facility type in input format 9. A format 10 card will be deleted if its ID number does not have a match on a format 9 card or if its ID number duplicates that of another format 10 card.

Columns 5-10 (6 column numeric field): Square feet per facility unit.

Columns 11-16 (6 column numeric field): Maintenance manhours per square foot per month.

Format 11: Training Administrative, Base Operating Support, and Medical Manpower Inputs Card Limit = 3 - This card contains inputs required for the derivation of training administrative, base operating support, and medical manpower.

Training administrative personnel perform training-related overhead functions not otherwise accounted for. This includes functions at the school-level (Administrative Affairs Office), at the department level (Administrative Section, Requirements Unit, and Instruction and Measurement Unit), and at the branch level (branch administration). It does not include the functions provided by the Training Services Division or the Instructor Training Division (school level) or the Curriculum Unit (department level), however.

Base operating support personnel perform the following base housekeeping and service functions: supply, transportation, security police, material staff, comptroller, personnel staff, food, commissary, housing, laundry and dry cleaning, recreation, education, transient aircraft maintenance, and general (not course specific) facility maintenance. Medical personnel provide medical and dental care to military personnel.

Columns 3-4 (2 column numeric field): Personnel Type: Numeric personnel type code as follows:

- 13 = Training Administrative
- 14 = Base Operating Support
- 15 = Medical

Columns 5-6 (2 column numeric field): Set to 01.

Columns 7-11 (5 column numeric field): Number of fixed manyears per course for support services.

Columns 12-16 (5 column numeric field): Number of variable manyears per Type A manyear for support services.

Columns 17-21 (5 column numeric field): Number of variable manyears per Type B manyear for support services.

Typical values for these parameters are shown below. Type A manyears are the sum of student, instructor, and curriculum personnel manyears. Type B manyears are the military TDY student manyears.

	<u>FIXED MANYEARS PER COURSE</u>	<u>VARIABLE MANYEARS PER TYPE A MANYEAR</u>	<u>VARIABLE MANYEARS PER TYPE B MANYEAR</u>
Training Administrative	3	.05	--
Base Operating Support	0	.08	.035
Medical	0	.02	.005

Format 12: Computer Management System Inputs Card Limit = 3 - The three hardware items of the computer management system are:

<u>CLASS</u>	<u>ITEM</u>
01	Mainframe (CPU and Main Memory)
02	Management Terminals
03	Auxiliary Storage

For each of these, the following data are entered:

- o Hardware class: as designated above
- o Hardware name: user selected name
- o Capacity of unit: for mainframe and management terminals, this is the number of CMI transactions per hour; for the auxiliary storage it is the number of student data sets (complete records of one student) that can be stored.
- o Yearly cost of unit: Total yearly cost of the unit; if leased or purchased, maintenance costs should be included.

Columns 3-5 (one column field): Hardware class.

Columns 6-35 (30 column alphanumeric field): Name of hardware device.

Columns 36-40 (5 column numeric field): Capacity of unit.

Columns 41-46 (5 column numeric field): Yearly cost of unit.

Format 13: Optional Officer/Airman/Civilian Distribution Overrides - This card provides the planner the option of overriding stored officer/airman/civilian distribution percentages. It is one of two input formats on which blanks and zeroes are differentiated. Thus, the planner needs to make entries only in the fields of those personnel types whose distribution he wishes to override; the other fields should be left blank. If the override values for a given personnel type do not total 100, then the model reinstates the stored values. The stored values are as follows:

	Officer %	Airman %	Civilian %
Curriculum	0	63	37
Hardware Maintenance	2	72	26
Facility Maintenance	0	100	0
Training Administrative	6	39	55
Base Operating Support	2	64	34
Medical	20	80	0

Columns 3-11 (three 3-column numeric fields): Curriculum manpower officer/airman/civilian distribution.

Columns 12-20 (three 3-column numeric fields): Hardware maintenance manpower officer/airman/civilian distribution.

Columns 21-29 (three 3-column numeric fields): Facility maintenance manpower officer/airman/civilian distribution.

Columns 30-38 (three 3-column numeric fields): Training administrative manpower officer/airman/civilian distribution.

Columns 39-47 (three 3-column numeric fields): Base operating support manpower officer/airman/civilian distribution.

Columns 48-56 (three 3-column numeric fields): Medical manpower officer/airman/civilian distribution.

Format 14: Optional Miscellaneous Overrides - This card allows the planner to override miscellaneous time and cost factors which have been stored as part of the program. It is the second of two input formats on which blanks and zeroes are differentiated. Thus, as before, the planner needs to make entries only in the fields of those factors which he wishes to override; the other fields should be left blank. The stored values are as follows:

Available Productive Manhours/Month	
Hardware Maintenance Personnel	121
All other Personnel Types	142
Average Number of Training Days per Month	21.7
Classroom Training Hours per Student per Day	7
Miscellaneous Supply Cost per Manyear (\$)	112
PCS Cost per Move (\$)	
Officer	879
Airman	224
Civilian	879
TDY Expense (\$)	
One-Way Transportation	85
Destination per Diem	
Officer	11
Airman	4
Civilian	21

Columns 3-10 (two 3-column numeric fields): Available productive manhours per month. Most AF training personnel have 142 hours per month available to perform productive work (174 assigned hours less 32 hours for leave, medical, training, and organizational duties). Hardware maintenance personnel, however, must spend part of that 142 hours waiting for parts and tools. This waiting time is estimated at 15% of available hours, thus reducing hardware maintenance available productive manhours per month to 121.

Columns 11-14 (4 column numeric field): Average number of training days per month.

Columns 15-18 (4 column numeric field): Classroom training hours per student per day. This value should coincide with the value listed on Worksheet 1.

Columns 19-23 (5 column numeric field): Miscellaneous supply cost per student per manyear: The cost of personnel supplies (food, clothing, etc.) and general office supplies (paper, pencils, forms, etc.) per manyear (students and permanent party).

Columns 24-35 (three 4-column numeric fields): PCS (Permanent Change of Station) cost per move (\$): Includes transportation of personnel and dependents; shipment and/or storage of household goods; and mileage per diem and subsistence allowance while in travel status.

Columns 36-39 (4 column numeric field): Average TDY one-way transportation cost (\$): Average cost of transportation and travel per diem to or from technical training center.

Columns 40-48 (three 3-column numeric fields): TDY destination per diem (\$): Average student cash entitlement while at technical training centers, after deductions for quarters and messing (when available).

Format 15: Optional Pay and Allowance Overrides - This card permits the planner to override the stored pay and allowance factors. The stored values are listed in Figure 10.

Columns 3-4 (2 column numeric fields): Personnel designator: Numeric personnel designator code as follows:

- 1 = Officer
- 2 = Airman
- 3 = Civilian - GS
- 4 = Civilian - WB
- 5 = Non-DoD

Use of a code outside the range 1 through 5 will result in the deletion of that card.

Columns 5-6 (2 column numeric field): Paygrade: Standard U.S. Government numeric paygrade codes. Card deletion will occur if the paygrade entered is not within the range of permissible paygrades for that personnel designator or if the personnel designator/paygrade combination duplicates that of another card.

<u>Personnel Designator</u>	<u>Permissible Paygrade Range</u>
Officer	0 or blank, 1-10
Airman	0 or blank, 1-9
Civilian - GS	0 or blank, 1-18
Civilian - WB	0 or blank, 1-14
Non-DoD	0 or blank, 1-20

Columns 7-11 (5 column numeric field): Annual pay and allowance factor (\$):
Annual pay and allowances per manyear.

Format 16: Lesson Descriptor Cards Card Limit = 75 - This card is used to describe each lesson in the new self-paced course. Thirteen descriptors are needed for each lesson. These variables are described in paragraph 4.2.2 of the report.

Columns 3-5 (3 column numeric field): Lesson ID number; a sequencing number assigned by the planner. This is used only for convenience in arranging the lessons. It is not used in the computations.

Columns 6-25 (20 column alphanumeric field): Lesson name; user selected name for lesson.

Columns 26-30 (5 column numeric field): The number of lecture/discussion minutes in the conventional course (CLDM). Taken directly from the POI.

Columns 31-35 (5 column numeric field): The number of demonstration/performance-cognitive minutes in the conventional course lesson (CDPMC). Taken directly from the POI.

Columns 36-40 (5 column numeric field): The number of minutes of memory content in the lesson (MEM). Provided by the course developer.

Columns 41-45 (5 column numeric field): The numerical rating from 0 to 5 of the simplicity or complexity of the memory content in the lesson (MSC). Provided by the course developer.

Columns 46-50 (5 column numeric field): The number of self-check items in the self-paced course lesson (SCKC). A design variable.

Columns 51-55 (5 column numeric field): The number of minutes of psychomotor task content in the lesson (PM). Provided by the course developer.

Columns 56-60 (5 column numeric field): The number of programmed instruction/ audiovisual minutes in the conventional course lesson (CPIAVM). Taken directly from the POI.

Columns 61-65 (5 column numeric field): The number of demonstration/performance- psychomotor minutes in the conventional course lesson (CDPMP). Taken directly from the POI.

Columns 66-70 (5 column numeric field): The numerical rating from 0 to 5 of the simplicity or complexity of the psychomotor content in the lesson (PMSC). Provided by the course developer.

Columns 71-75 (5 column numeric field): The number of minutes of cognitive content in the lesson (COG). Provided by the course developer.

Columns 76-80 (5 column numeric field): The number of outside assignment minutes in the conventional course (COUTM). Taken directly from the POI.

Format 99: Termination Card - No entries other than the "99" in columns 1 and 2 need be made.

Computer Program Output Description

The output from the computer program is illustrated in this section through the use of an example run from the program. Since much of the output format remains as it was designed by Rand for the MODCOM Program, we have summarized their descriptions as in MODIA: The Cost Model (Hess & Kantar, 1976). The user of the model will note that some small rounding errors occur in the totals.

Output 1 (Figure A-1) - This is an exact echo of the input data. Card columns are shown on the top of the page so any misalignment of data or input is apparent.

Output 1a (no figure) - This section contains error messages relating to data that were found to be outside the specified range, or from duplicate cards. Fatal errors, such as no lesson descriptors or the omission of the end of data card (Format 99) will also appear here.

Output 2 (Figure A-2) - This output lists the values assigned to each variable in the lesson descriptor set. Only those lessons which have passed the tests for acceptable range appear here.

Output 3 (Figure A-3) - This table lists the computed time to complete each lesson for students with various student variable values. Times are shown in hours. Total course time for each time student is shown, as well as the weighted average time to complete the course, and the percentage timesaving (if TPOI is given).

Output 4 (Figure A-4) - This output lists the personnel distributions and cost factors stored as part of the model. These may be overridden by inputting data (Formats 14-16).

Output 5, Graduat Summary (Figure A-5) - Output 5 is a time-phased summary of Active Duty Force, Guard and Reserve, other DoD and Non-DoD graduates. The numbers reflect only those students who actually graduate in that year. For example, if the course duration were greater than one year, then no graduates would appear in year 1. The "in progress" column indicates the number of students who entered in years 4 and 5 but who will not graduate until years 6 or 7. All Air Force students except those assigned to the Air National Guard and the Air Force Reserve are termed Active Duty Force. Guard and Reserve refers only to Air Force Guard and Reserve students. Students assigned to DoD agencies other than the AF, such as the Army and Navy (including their Guard and Reserve components) are classified as other DoD. Finally, students from non-DoD agencies, including foreign governments (e.g., Military Assistance Program), are termed Non-DoD.

Output 6, Manpower Summary (Figure A-6) - Output 6 is a two part, time-phased summary of student and base permanent party manyears. Part 1 is a functional breakdown covering all course personnel while Part 2 is a PCS/TDY breakdown limited to AF personnel.

Part 1

Total Student Load: Total student manyears.

Instructors include all academic, remedial and special requirements instructors as well as course monitors and supervisors.

Curriculum Personnel determine training requirements and develop course written materials. Normally attached to the Curricula of a training department, these personnel share the task of courseware development with the course's instructors.

Hardware Maintenance Personnel are responsible for the preventive and corrective maintenance of course hardware. Media hardware maintenance is generally the responsibility of the Training Services Division (school level), while all other

types of hardware are usually serviced by the base Maintenance and Supply Group or a specialized maintenance squadron.

Facilities Maintenance Personnel are responsible for the maintenance and repair (including custodial service) of course-related facilities.

Training Administrative Personnel perform training-related overhead functions not otherwise accounted for. This includes functions at the school level (Administrative Division, Training Evaluation Division, Operations Division, and Foreign Military Affairs Office), at the department level (Administrative Section, Requirements Unit, and Instruction and Measurement Unit), and at the branch level (branch administration). It does not include the functions provided by the Training Service Division or the Instructor Training Division (school level) or the Curricula Unit (department level), however.

Base Operating Support (BOS) personnel perform the following base housekeeping and service functions: supply, transportation, security police, material staff, comptroller, personnel staff, food, commissary, housing, laundry and dry cleaning, recreation, education, transient aircraft maintenance, and general (not course specific) facility maintenance.

Medical Personnel provide medical and dental care to military personnel.

Total Base Permanent Party represents those personnel assigned to a base for the purpose of performing duty in the furtherance of the mission of that base. Thus, students are excluded from this total.

Total Course Manyears represents total student load plus total base permanent party.

Part 2

Active Duty Force PCS Student Load: The number of PCS* manyears accrued by Active Duty Force students. Pipeline students are always assumed to be PCS while lateral and upgrade students are PCS only if the course duration is 20 weeks or more.

Base Permanent Party - AF Only: Total base permanent party less non-AF instructors. Specific program elements charged are:

Specialized Training

Air Force Instructors

Curriculum Personnel

Hardware Maintenance Personnel

Training Administrative Personnel

*Permanent Change of Station means the reassignment of a military person from one permanent duty station to another.

Hospitals

Medical Personnel assigned to hospitals

Real Property Maintenance Activities

Facilities Maintenance Personnel (course-related)

Facility-related portion of BOS Personnel (general base housekeeping)

Base Operations

BOS Personnel (except facility-related portion)

Medical Personnel assigned to dispensaries

Active Duty Force TDY Student Load: Number of TDY* manyears accrued by Active Duty Force students including Program 8 TDY students. Pipeline students are never TDY while lateral and upgrade students are TDY only if the course duration is less than 20 weeks. They may be assigned to any program element in Air Force Programs 1-4 and 6-10.

Guard and Reserve Student Load: Number of manyears (PCS and TDY) accrued by Air Force Guard and Reserve students. All Guard and Reserve manyears are charged to Program 5.

Total Air Force Manyears: The sum of total Program 8 manyears, Active Duty Force TDY student manyears, and Guard/Reserve student manyears.

Output 7, Courseware, Hardware, and Facility Requirements (Figure A-7) - Output 7 is a summary of key courseware, hardware, and facility inputs and computer requirements.

Output 8, Functional Cost Summary (Figure A-8) - Output 8 is a breakdown of total course costs by function.

Investment Costs

Courseware Procurement includes four separate costs: (1) the initial cost of producing the master from which all subsequent copies will be made; (2) the cost of reproducing and packaging the required number of copies; (3) the annual cost of revision due to change in course content; and (4) the annual cost of replacement due to loss, damage, and normal wearout. It does not include the cost of courseware

**Temporary Duty means duty at a location other than the permanent duty station at which a member performs temporarily under orders which provide either reassignment to the old permanent station or assignment to a new permanent station.

development such as script writing and editing, which is accounted for within curriculum manpower pay and allowances.

Hardware Procurement embraces the following cost elements: (1) the cost of purchasing the incremental number of units required each year, including initial replacement part stocks; (2) credits for any surplus items returned to the Stock Fund; and (3) the annual cost of replacing those units worn out during the year. The annual cost of replenishment repair parts is accounted for elsewhere. Negative numbers indicate a dominance of Stock Fund credits.

Facility Construction represents the total cost of constructing and/or modifying facilities required for course use.

Operating Costs

Pay and Allowances provides for all officer, airman, and civilian pay and allowances. The elements accounted for are as follows:

<u>Officers</u>	<u>Airmen</u>	<u>Civilian</u>
Basic Pay	Basic Pay	Basic Pay
Special Pay	Special Pay	Life Insurance
Basic Allowance for Quarters	Proficiency Pay	Health Benefits
Basic Allowance for Subsistence	Reenlistment Bonus	Terminal Leave
Uniform Allowance	Basic Allowance for Quarters	Workman's Compensation
Family Separation Allowance	Clothing Allowance	Civilian Retirement
Separation Payments	Separation Payments	Overtime
Social Security Tax - Employer's Contribution	Social Security Tax - Employer's Contribution	

PCS Costs include the expenses incident to the permanent change of station of students and instructors: transportation of personnel and dependents; shipment and/or storage of household goods; and mileage per diem and subsistence allowances while in travel status.

TDY Costs include commercial transportation, car rental, mileage allowances and tools, per diem, and incidental expenses incurred by students in authorized travel status.

Instructor Training is composed of instructor education training costs (the cost of the six-week instructor prerequisite course on education principles) and initial factory training costs (the cost of providing the initial instructor cadre with necessary specialized equipment or system training).

Miscellaneous Operating Costs consists of three distinct elements:

1. Computer Service Charges: Any computer expenses incurred as a result of using computer based instruction.
2. Hardware Replenishment Repair Parts: The cost of purchasing miscellaneous hardware repair parts.
3. Miscellaneous Supplies: The cost of personnel supplies (food, clothing, etc.) and general office supplies (paper, pencils, forms, etc.).

The planner should carefully inspect each type of output to assure himself that the answers are reasonable. Areas where large costs appear may focus further planning effort to reducing these costs.

AIDE TEST RUN 1 (STANDARD SAMPLE)									
INPUT DATA									
=====									
1	2	3	4	5	6	7	8	9	0
1	0	0	0	0	0	0	0	0	0
2	0	0	0	0	0	0	0	0	0
3	0	0	0	0	0	0	0	0	0
4	0	0	0	0	0	0	0	0	0
5	0	0	0	0	0	0	0	0	0
6	0	0	0	0	0	0	0	0	0
7	0	0	0	0	0	0	0	0	0
8	0	0	0	0	0	0	0	0	0
9	0	0	0	0	0	0	0	0	0
10	0	0	0	0	0	0	0	0	0
11	0	0	0	0	0	0	0	0	0
12	0	0	0	0	0	0	0	0	0
13	0	0	0	0	0	0	0	0	0
14	0	0	0	0	0	0	0	0	0
15	0	0	0	0	0	0	0	0	0
16	0	0	0	0	0	0	0	0	0
17	0	0	0	0	0	0	0	0	0
18	0	0	0	0	0	0	0	0	0
19	0	0	0	0	0	0	0	0	0
20	0	0	0	0	0	0	0	0	0
21	0	0	0	0	0	0	0	0	0
22	0	0	0	0	0	0	0	0	0
23	0	0	0	0	0	0	0	0	0
24	0	0	0	0	0	0	0	0	0
25	0	0	0	0	0	0	0	0	0
26	0	0	0	0	0	0	0	0	0
27	0	0	0	0	0	0	0	0	0
28	0	0	0	0	0	0	0	0	0
29	0	0	0	0	0	0	0	0	0
30	0	0	0	0	0	0	0	0	0
31	0	0	0	0	0	0	0	0	0
32	0	0	0	0	0	0	0	0	0
33	0	0	0	0	0	0	0	0	0
34	0	0	0	0	0	0	0	0	0
35	0	0	0	0	0	0	0	0	0
36	0	0	0	0	0	0	0	0	0
37	0	0	0	0	0	0	0	0	0
38	0	0	0	0	0	0	0	0	0
39	0	0	0	0	0	0	0	0	0
40	0	0	0	0	0	0	0	0	0
41	0	0	0	0	0	0	0	0	0
42	0	0	0	0	0	0	0	0	0
43	0	0	0	0	0	0	0	0	0

FIGURE A-1. OUTPUT 1: INPUT DATA

```

.....
AIDE TEST RUN 1 (STANDARD SAMPLE)
.....
INPUT DATA
=====
1      1      2      3      4      5      6      7      8
0      0      0      0      0      0      0      0      0
.....
44. 12 3DISK STORAGE
45. 12 2MANAGEMENT TERMINAL
46. 16 01LESSON ONE
47. 16 02LESSON TWO
48. 16 03LESSON THREE
49. 16 04LESSON FOUR
50. 16 05LESSON FIVE
51. 16 06LESSON SIX
52. 16 07LESSON SEVEN
53. 16 08LESSON EIGHT
54. 16 09LESSON NINE
55. 16 10LESSON TEN
56. 99
.....
1000 5000.
90. 16000
89 55 69 2.6 2.7 21 8 28 1.2 1.45 51
89 55 69 2.6 2.7 21 8 28 1.2 1.45 51
89 55 69 2.6 2.7 21 8 28 1.2 1.45 51
89 55 69 2.6 2.7 21 8 28 1.2 1.45 51
89 55 69 2.6 2.7 21 8 28 1.2 1.45 51
89 55 69 2.6 2.7 21 8 28 1.2 1.45 51
89 55 69 2.6 2.7 21 8 28 1.2 1.45 51
89 55 69 2.6 2.7 21 8 28 1.2 1.45 51
89 55 69 2.6 2.7 21 8 28 1.2 1.45 51
89 55 69 2.6 2.7 21 8 28 1.2 1.45 51
.....

```

FIGURE A-1. OUTPUT 1: INPUT DATA (Cont.)

EVALUATING INSTRUCTIONAL SYSTEMS

VOLUME II

MDC E1570
15 MAY 1977

AIDE TEST RUN 1 (STANDARD SAMPLE)
LESSON DESCRIPTORS

ID	NAME	CLDM	CDPMC	MEM	MSC	SKKC	PM	CPIAWH	CDMPH	PMSC	COG	COUTH
1	LESSON ONE	89.0	55.0	69.0	2.6	2.7	21.0	9.0	28.0	1.2	145.0	51.0
2	LESSON TWO	89.0	55.0	69.0	2.6	2.7	21.0	9.0	28.0	1.2	145.0	51.0
3	LESSON THREE	89.0	55.0	69.0	2.6	2.7	21.0	9.0	28.0	1.2	145.0	51.0
4	LESSON FOUR	89.0	55.0	69.0	2.6	2.7	21.0	9.0	28.0	1.2	145.0	51.0
5	LESSON FIVE	89.0	55.0	69.0	2.6	2.7	21.0	9.0	28.0	1.2	145.0	51.0
6	LESSON SIX	89.0	55.0	69.0	2.6	2.7	21.0	9.0	28.0	1.2	145.0	51.0
7	LESSON SEVEN	89.0	55.0	69.0	2.6	2.7	21.0	9.0	28.0	1.2	145.0	51.0
8	LESSON EIGHT	89.0	55.0	69.0	2.6	2.7	21.0	9.0	28.0	1.2	145.0	51.0
9	LESSON NINE	89.0	55.0	69.0	2.6	2.7	21.0	9.0	28.0	1.2	145.0	51.0
10	LESSON TEN	89.0	55.0	69.0	2.6	2.7	21.0	9.0	28.0	1.2	145.0	51.0

*SEE "LESSON DESCRIPTOR CARDS," PAGE A-23, FOR DEFINITIONS OF COLUMN HEADINGS.

FIGURE A-2. OUTPUT 2: LESSON DESCRIPTOR VALUES

```

*****
AIDE TEST RUN 1(STANDARD SAMPLE)
*****
**COURSE COMPLETION DATA (IN HOURS)**
*****

STUDENT VARIABLES      ASVADM      84.  72.  60.  48.  36.
ASVMEC                 1.  1.  1.  1.  1.
SEX                    1.  1.  1.  1.  1.

LESSON NAME
1 LESSON ONE          1.7  1.8  1.9  2.0  2.1
2 LESSON TWO          1.7  1.8  1.9  2.0  2.1
3 LESSON THREE        1.7  1.8  1.9  2.0  2.1
4 LESSON FOUR         1.7  1.8  1.9  2.0  2.1
5 LESSON FIVE         1.7  1.8  1.9  2.0  2.1
6 LESSON SIX          1.7  1.8  1.9  2.0  2.1
7 LESSON SEVEN        1.7  1.8  1.9  2.0  2.1
8 LESSON EIGHT        1.7  1.8  1.9  2.0  2.1
9 LESSON NINE         1.7  1.8  1.9  2.0  2.1
10 LESSON TEN         1.7  1.8  1.9  2.0  2.1

STUDENT VARIABLES      COURSE
                        COMPLETION
ASVADM ASVMEC SEX      TIME (HRS)
84.  85.  1.          17.0
72.  72.  1.          18.1
60.  59.  1.          19.2
48.  46.  1.          20.2
36.  33.  1.          21.3

AVERAGE COURSE COMPLETION TIME IS 19.17 HOURS
AVERAGE TIME SAVING IS 52.1 PERCENT

```

FIGURE A-3. OUTPUT 3: COURSE COMPLETION DATA


```

.....
AIDE TEST RUN (STANDARD SAMPLE)
.....
PROGRAM CONSTANTS
=====
OFFICER/AIRMAN/CIVILIAN DISTRIBUTION
CURRICULUM
OFF      0.
AMN     63.
CIV     37.

HARDWARE
OFF      2.
AMN     72.
CIV     25.

FACILITY
OFF      0.
AMN    100.
CIV      0.

TRAINING ADMINISTRATIVE
OFF      5.
AMN     39.
CIV     55.

BASE OPERATIONS
OFF      2.
AMN     64.
CIV     34.

MEDICAL
OFF     20.
AMN     90.
CIV      0.

AVAILABLE PRODUCTIVE MAN-HOURS/MONTH
HARDWARE MTC      121.
ALL OTHERS      142.

AVERAGE TRAINING DAYS/MONTH      21.7

AVERAGE CLASSROOM TRAINING HRS/STUDENT/DAY      5.

MISC. SUPPLY COST/MAN-YEAR ($)      112.

PCS COST/MOVE ($)
OFF      679.
AMN     224.
CIV     879.

TOY EXPENSE
AVG. ROUND TRIP TRANSP. COST ($)      63.
DESTINATION PER DIEM
OFF      11.
AMN      4.
CIV     21.

* INDICATES USER OVERRIDE VALUE (IF ANY)

```

FIGURE A-4. OUTPUT 4: PERSONNEL DISTRIBUTIONS AND COST FACTORS (Cont.)

GRADUATE SUMMARY
=====

AVERAGE COURSE DURATION FOR GRADUATES = 19.2 HOURS

WASHOUT RATE = 10.0

AVERAGE COURSE DURATION FOR WASHOUTS = 4.8 HOURS

STUDENT ENTRY INTERVAL = 30.0 HOURS

GRADUATE TYPE	NUMBER OF GRADUATES BY YEAR					SUBTOTAL	IN PROGRESS	TOTAL
	1	2	3	4	5			
ACTIVE DUTY FORCES	=====	=====	=====	=====	=====	=====	=====	=====
OFFICERS	0.	0.	0.	0.	0.	0.	0.	0.
ARMEN	2870.	2880.	2880.	2880.	2890.	14390.	10.	14400.
CIVILIANS	0.	0.	0.	0.	0.	0.	0.	0.
GUARD AND RESERVE FORCES								
OFFICERS	0.	0.	0.	0.	0.	0.	0.	0.
ARMEN	0.	0.	0.	0.	0.	0.	0.	0.
CIVILIANS	0.	0.	0.	0.	0.	0.	0.	0.
OTHER DOD (ARMY,NAVY)								
OFFICERS	0.	0.	0.	0.	0.	0.	0.	0.
ARMEN	0.	0.	0.	0.	0.	0.	0.	0.
CIVILIANS	0.	0.	0.	0.	0.	0.	0.	0.
NON-DOD (MAP)	0.	0.	0.	0.	0.	0.	0.	0.
TOTAL GRADUATES	2870.	2880.	2880.	2880.	2880.	14390.	10.	14400.
TOTAL ENTRANTS	3280.	3200.	3200.	3200.	3200.	16000.		16000.
TOTAL WASHOUTS	324.	320.	320.	320.	320.	1604.	-4.	1600.

FIGURE A-5. OUTPUT 5: GRADUATE SUMMARY

AIDE TEST RUN 1 (STANDARD SAMPLE)

MANPOWER SUMMARY (MAN-YEARS)

	YEAR					TOTAL
	0	1	2	3	4	5
STUDENTS						
ACTIVE DUTY FORCE	0.0	0.0	0.0	0.0	0.0	0.0
OFFICER	0.0	36.2	36.2	36.2	36.2	181.0
ARMEN	0.0	0.0	0.0	0.0	0.0	0.0
CIVILIAN	0.0	0.0	0.0	0.0	0.0	0.0
GUARD AND RESERVE	0.0	0.0	0.0	0.0	0.0	0.0
OFFICER	0.0	0.0	0.0	0.0	0.0	0.0
ARMEN	0.0	0.0	0.0	0.0	0.0	0.0
CIVILIAN	0.0	0.0	0.0	0.0	0.0	0.0
OTHER DOD (ARMY,NAVY)	0.0	0.0	0.0	0.0	0.0	0.0
OFFICER	0.0	0.0	0.0	0.0	0.0	0.0
ARMEN	0.0	0.0	0.0	0.0	0.0	0.0
CIVILIAN	0.0	0.0	0.0	0.0	0.0	0.0
NON-DOD (MAP)	0.0	0.0	0.0	0.0	0.0	0.0
* TOTAL STUDENT LOAD	0.0	36.2	36.2	36.2	36.2	181.0
BASE PERMANENT PARTY						
INSTRUCTORS	1.3	9.0	9.0	9.0	9.0	46.3
AIR FORCE	.5	12.0	12.0	12.0	12.0	60.5
OTHER DOD (ARMY,NAVY)	5.4	.5	.5	.5	.5	7.9
CURRICULUM PERSONNEL	0.0	4.3	4.3	4.3	4.3	21.5
WARDWARE MAINTENANCE PERSONNEL	0.0	1.4	1.4	1.4	1.4	7.0
FACILITIES MAINTENANCE PERSONNEL	0.0	5.9	5.9	5.9	5.9	29.5
TRAINING ADMINISTRATIVE PERSONNEL	.6	5.5	5.5	5.5	5.5	28.1
BASE OPERATING SUPPORT PERSONNEL	.1	1.1	1.1	1.1	1.1	5.6
MEDICAL PERSONNEL	7.9	39.7	39.7	39.7	39.7	206.4
* TOTAL BASE PERMANENT PARTY	7.9	75.9	75.9	75.9	75.9	387.4
* TOTAL COURSE MAN-YEARS						
ACTIVE DUTY FORCE PCS STUDENT LOAD	0.0	36.2	36.2	36.2	36.2	181.0
BASE PERMANENT PARTY - AF ONLY	7.4	27.7	27.7	27.7	27.7	145.9
* TOTAL PROGRAM 1 MAN-YEARS	7.4	63.9	63.9	63.9	63.9	326.9
ACTIVE DUTY FORCE TOY STUDENT LOAD	0.0	0.0	0.0	0.0	0.0	0.0
GUARD AND RESERVE STUDENT LOAD	0.0	0.0	0.0	0.0	0.0	0.0
* TOTAL AIR FORCE MAN-YEARS	7.4	63.9	63.9	63.9	63.9	326.9

FIGURE A-6. OUTPUT 6: MANPOWER SUMMARY

EVALUATING INSTRUCTIONAL SYSTEMS

VOLUME II

MDC E1570
15 MAY 1977

AIIDE TEST RUN 1 (STANDARD SAMPLE)

COURSEWARE, HARDWARE, AND FACILITIES REQUIREMENTS BY YEAR

*** COURSEWARE ***									
NAME OF COPY MEASURE	NAME OF COPY MEASURE	INITIAL PREP. COST (\$)/MEASURE	COPY COST (\$)/MEASURE	ANNUAL REVISION RATE (%)	COPIES REQUIRED BY YEAR				
					1	2	3	4	5
PRINTED MEDIA									
PROGRAMMED TEXTS	BOOK PAGE	350.	4.50	.010	3224.	3203.	3203.	3203.	3203.
INSTRUCTOR LESSONS	BOOK PAGE	700.	4.50	.010	24.	3.	3.	3.	3.
DISPLAY MEDIA									
VIDEO TAPE	REEL MINUTE	30.	300.00	5.000	1.	1.	1.	1.	1.
VIDEO TAPEZ	REEL MINUTE	45.	300.00	5.000	1.	1.	1.	1.	1.
NARRATED SLIDES	SET SLIDE	75.	15.00	.062	1.	1.	1.	1.	1.
SOFTWARE									
CLS TEACHING MACH PRG	PROG INST	220.	30.00	.010	1.	1.	1.	1.	1.
*** HARDWARE ***									
UNIT COST (\$)	REPAIR PART COST (\$)/UNIT/YR.	RETURN-ABLE FOR CREDIT	ANNUAL LOSS RATE (%)	FAILURES/HOUR OF USAGE	TIME TO REPAIR/FAILURE (HOURS)				
					1	2	3	4	5
MEDIA HARDWARE									
35MM SLIDE PROJECTOR	140.	20.	YES	5.0	10.	10.	10.	10.	10.
8MM REEL TO REEL PROJECTOR	225.	35.	YES	10.0	10.	10.	10.	10.	10.
8MM CARTRIDGE PROJECTOR	615.	35.	YES	10.0	19.	19.	19.	19.	19.
CLS TEACHING MACHINE	150.	75.	NO	0.0	5.	5.	5.	5.	5.
SPECIAL EQUIPMENT									
NONE									
OVERHEAD HARDWARE									
LEARNING CARREL	180.	0.	YES	0.0	46.	46.	46.	46.	46.
*** FACILITIES ***									
NAME	UNIT COST (\$)	SQUARE FEET/FACILITY	MAINT. MAN-HOURS/SQ. FT./MONTH	UNITS REQUIRED BY YEAR					
				1	2	3	4	5	
CLASSROOM	10000.	2500.	.01250	1.	1.	1.	1.	1.	1.
LABORATORY	75000.	8100.	.02000	1.	1.	1.	1.	1.	1.
*** CMI SYSTEM ***									
NAME	UNIT COST (\$)	UNIT CAPACITY	UNITS REQUIRED BY YEAR						
			1	2	3	4	5		
MAINFRAME	45000.	10000.	1.	1.	1.	1.	1.	1.	1.
DISK STORAGE	5000.	1000.	1.	1.	1.	1.	1.	1.	1.
MANAGEMENT TERMINAL	16000.	90.	1.	1.	1.	1.	1.	1.	1.

FIGURE A-7. OUTPUT 7: COURSEWARE, HARDWARE, AND FACILITIES REQUIREMENTS

VOLUME II

MAIDE TEST RUN 1 (STANDARD SAMPLE)

FUNCTIONAL COST SUMMARY (IN THOUSANDS OF DOLLARS)

	YEAR						
	0	1	2	3	4	5	TOTAL
	=====	=====	=====	=====	=====	=====	=====
COURSEWARE PROCUREMENT							
PRINTED MEDIA	0.0	31.5	26.3	26.3	26.3	26.3	136.7
DISPLAY MEDIA	0.0	28.8	4.8	4.8	4.8	4.8	48.0
SOFTWARE	0.0	7.9	1.3	1.3	1.3	1.3	13.1
HARDWARE PROCUREMENT							
MEDIA HARDWARE	0.0	15.0	1.6	1.6	1.6	1.6	22.4
SPECIAL EQUIPMENT	0.0	0.0	0.0	0.0	0.0	0.0	0.0
OVERHEAD HARDWARE	0.0	2.0	0.0	0.0	0.0	0.0	2.0
FACILITY CONSTRUCTION	0.0	75.0	0.0	0.0	0.0	0.0	75.0
PAY AND ALLOWANCES							
STUDENTS	0.0	219.1	218.4	218.4	218.4	218.4	1091.7
INSTRUCTORS	28.4	323.2	323.2	323.2	323.2	323.2	1644.8
CURRICULUM PERSONNEL	54.3	5.0	5.0	5.0	5.0	5.0	79.3
HARDWARE MAINTENANCE PERSONNEL	0.0	40.9	40.9	40.9	40.9	40.9	204.5
FACILITIES MAINTENANCE PERSONNEL	0.0	12.0	12.0	12.0	12.0	12.0	60.0
TRAINING ADMINISTRATIVE PERSONNEL	0.0	67.0	67.0	67.0	67.0	67.0	335.0
BASE OPERATING SUPPORT PERSONNEL	5.4	53.5	53.5	53.5	53.5	53.5	273.3
MEDICAL PERSONNEL	1.1	11.6	11.6	11.6	11.6	11.6	59.1
PCS COSTS	0.0	1432.3	1433.6	1433.6	1433.6	1433.6	7166.7
STUDENTS	7.7	5.9	2.7	2.7	2.7	2.7	25.4
INSTRUCTORS							
TRANSPORTATION	0.0	0.0	0.0	0.0	0.0	0.0	0.0
DESTINATION PER DIEM	0.0	0.0	0.0	0.0	0.0	0.0	0.0
INSTRUCTOR TRAINING							
FACTORY TRAINING OF INITIAL INSTR. CADRE	3.0	0.0	0.0	0.0	0.0	0.0	3.0
EDUCATION TRAINING	16.5	19.6	4.5	4.5	4.5	4.5	54.2
MISCELLANEOUS OPERATING COSTS							
COMPUTER SERVICE CHARGES	0.0	65.0	56.0	66.0	56.0	66.0	330.0
HARDWARE REPLACEMENT REPAIR PARTS	0.0	1.6	1.6	1.6	1.6	1.6	9.0
MISCELLANEOUS SUPPLIES	.9	8.5	8.5	9.5	8.5	9.5	43.4
	=====	=====	=====	=====	=====	=====	=====
TOTAL COURSE COST	118.2	2427.4	2292.5	2292.5	2292.5	2292.5	11675.6
TOTAL COST LESS STUDENT PAY	118.2	2209.3	2064.1	2064.1	2064.1	2064.1	10583.9

FIGURE A-8. OUTPUT 8: FUNCTIONAL COST SUMMARY

APPENDIX B
FORTRAN LISTING OF AIDE PROGRAM

DATE: 04/25/77
TIME: 10.11.00

PROGRAM AIDE
MDL 3 AIDE

SHARED

PAGE 2

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1  PROGRAM AIDE(INPUT=1013,OUTPUT=1018,TAPE5=INPUT,TAPE6=OUTPUT,
2  XTAPE8=1019)
3  C.....
4  C PROGRAM AIDE WAS WRITTEN FOR THE ARPA STUDY,75 SEPT. TO 76 SEPT,
5  C AND IS USED TO ESTIMATE THE COST OF DEVELOPING AND OPERATING
6  C A MAINLINE,SELF PAGED COURSE FOR A PERIOD OF FIVE YEARS.
7  C THE PROGRAM WAS DEVELOPED FROM THE RAND COMPUTER PROGRAM
8  C #MODCOM,DEVELOPED UNDER MS. POLLY CARPENTER-HUFFMAN. THIS
9  C PROGRAM IS AN EXTENSION OF THAT MODEL IN THAT COURSE DURATION
10 C IS COMPUTED FROM LESSON DESCRIPTORS USING A REGRESSION MODEL
11 C DEVELOPED UNDER THE ARPA STUDY,AND IN THAT RESOURCES REQUIRED
12 C ARE ESTIMATED DIRECTLY.
13 C.....
14 C
15 C QUESTIONS REGARDING THIS MODEL SHOULD BE DIRECTED TO:
16 C
17 C ROBERT A. VECCHIOTTI
18 C MCDONNELL DOUGLAS ASRONAUTICS COMPANY-EAST
19 C P.O. BOX 516
20 C ST. LOUIS, MO. 63166
21 C PHONE (314)-232-6743
22 C .....
23 C
24 C INTEGER U,D,S,T,C,R,H,E,F,G,A,B,0,0,0,P,M
25 C INTEGER ST,SPD,SPG,SIM
26 C INTEGER TT,TPD,TPG
27 C INTEGER CIO,CC
28 C INTEGER RDX,RINX,RID,RIM
29 C INTEGER MID,MC,MOD
30 C INTEGER EIDX,EINX,EID,EIM
31 C INTEGER FID
32 C INTEGER GIDX,GIMX,GID,GIM
33 C INTEGER BID
34 C INTEGER APT,AIM
35 C INTEGER PPD,PPG
36 C COMMON/ALL/ NTYPE(20),LPP,NLINES,IPAGE,TITLE(39),IFLAG,
37 C U,D,S,T,C,R,H,E,F,G,A,B,0,0,0,P,M
38 C COMMON/D/ DCCO,DMR,DMCO,DEI
39 C COMMON/S/ ST(75),SPD(75),SPG(75),SIM(75),SNGRAD(7,75),
40 C SNYS(17,75),SENTSI(7,75),SNWASH(7,75)
41 C COMMON/--- (25),TPD(25),TPG(25),TSIIC(25),TN(6,25),TTR(25),
42 C TA,TIFTC,TEIC
43 C COMMON/--- (75),CC(75),CTYPE(11,75),CCOPY(12,75),CHEAS(13,75),
44 C KQ(15,75),CNMU(75),CIPCH(75),CCCH(75),CPCC(75),
45 C JARV(75),CARP(75)
46 C COMMON/ RDX(75),RINX(75),RID(75),RIM(75),RNCHX(75),
47 C RMPCHX(75),RIPAX(75),RNPX(6,75),RNCH(75),
48 C RMPCH(75),RIPA(75),RNP(6,75)
49 C COMMON/H/ HID(75),HC(75),HOD(75),HODE(75),HNURO(15,75),
50 C HNUAV(75),HPCU(75),HAAF(75),HRCU(75),HISRI(75)

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MDC E1570
15 MAY 1977

MCDONNELL DOUGLAS ASTRONAUTICS COMPANY - EAST

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DATE: 04/25/77          PROGRAM AIDE          PAGE 5
LINE: 10.12.55          MDL 5 SPOILER2
1 C *** PAY FACTOR TABLES (OFFICERS, AIRMEN, CIV-GR, CIV-WB, FOREIGN) ***
2 C
3 DATA OFF(1),OFF(2),OFF(3),OFF(4),OFF(5),OFF(6),
4 X OFF(7),OFF(8),OFF(9),OFF(10)
5 X /1004..1361..17476..20624..24987..29384..
6 X 33867..38385..40041..43084..
7 C
8 DATA AMN(1),AMN(2),AMN(3),AMN(4),AMN(5),AMN(6),
9 X AMN(7),AMN(8),AMN(9)
10 X / 5430.. 6027.. 6579.. 7791.. 9583..11201..
11 X 12779..14635..17002..
12 C
13 DATA CGS(1),CGS(2),CGS(3),CGS(4),CGS(5),CGS(6),
14 X CGS(7),CGS(8),CGS(9),CGS(10),CGS(11),CGS(12),
15 X CGS(13),CGS(14),CGS(15),CGS(16),CGS(17),CGS(18)
16 X / 5651.. 8447.. 7953.. 9266..10483..11782..
17 X 13824..14254..15171..17041..18935..22285..
18 X 28053..10377..35823..39060..39060..
19 C
20 DATA CMB(1),CMB(2),CMB(3),CMB(4),CMB(5),CMB(6),
21 X CMB(7),CMB(8),CMB(9),CMB(10),CMB(11),CMB(12),
22 X CMB(13),CMB(14)
23 X / 7912.. 8491.. 8896.. 9214.. 9587..10527..
24 X 11077..11671..12124..12758..13373..13945..
25 X 14776..15157..
26 DATA OFFAV/18297.. / AMNAV/ 8551.. / CGSAV/12599.. / CMBAV/11464.. /
27 X FORAV/ 0.. /
28 C
29 CALL INITFOR,20)
30 C
31 C
32 C
33 C *** MISCELLANEOUS PROGRAM CONSTANTS (SEE BLOCK DATA SUBPROGRAM) ***
34 C
35 C
36 C *****RHPK
37 C *****INITIALIZATION - MAIN PROGRAM *****
38 C *****RHPK
39 C
40 C
41 9000 CONTINUE
42 NTOTCO = 0
43 NCARDS = 0
44 U = 1
45 D = 2
46 S = 3
47 T = 4
48 C = 5
49 R = 6
50 M = 7

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DATE: 04/25/77
LINE: 101255
PROGRAM AIDE
SHARED MDL 4 SPOOLER02
PAGE 6

51 E = 8
52 F = 9
53 G = 10
54 A = 11
55 B = 12
56 C = 13
57 D = 14
58 E = 15
59 F = 16
60 NTYPE=16
61 CALL INITI(NTYPE,20)
62 CALL INITI(NTYPE,20)
63 IPAGE = 0
64 NLINES = 0
65 LPP = 55
66 CALL INITF(PAY,100)
67 CALL INITA(XPFLG,100)
68 CALL INITA(XVFLG,5)
69
70 C *** INITIALIZE ALL INPUT VARS. TO 0 ***
71 C
72 DGC0 = 0.
73 DMR = 0.
74 DMCD = 0.
75 DEI=0.
76 C.....RHPK
77 C
78 CALL INITI(ST,75)
79 CALL INITI(SPD,75)
80 CALL INITI(SPG,75)
81 CALL INITI(SI,75)
82 CALL INITI(SNGRAD,525)
83 CALL INITI(SMYRS,525)
84 CALL INITI(SENTS,525)
85 CALL INITI(SNASH,525)
86 C.....RHPK
87 C
88 CALL INITI(TT,25)
89
90 CALL INITI(TPO,25)
91 CALL INITI(TPG,25)
92 CALL INITI(TSIC,25)
93 CALL INITI(TN,150)
94 CALL INITI(TTR,25)
95 C.....RHPK
96 C
97 CALL INITI(CIO,75)
98 CALL INITI(CC,75)
99 CALL INITI(CTYPE,825)
100 CALL INITI(CCOPY,150)
101 CALL INITI(CHEAS,225)

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DATE: 04/25/77
TIME: 10.12.55
PAGE: 7

PROGRAM AIDE
MDL 4 SPOLLER02

101 CALL INITF(CNURQ,375)
102 CALL INITF(CNMU,75)
103 CALL INITF(CIPCM,75)
104 CALL INITF(CCCM,75)
105 CALL INITF(CPCG,75)
106 CALL INITF(CARV,75)
107 CALL INITF(CAR2,75)
108 C.....RHPK
109 C
110 CALL INITF(RIX,75)
111 CALL INITF(RIM,75)
112 CALL INITF(RID,75)
113 CALL INITF(RIM,75)
114 CALL INITF(RNCH,75)
115 CALL INITF(RMCHX,75)
116 CALL INITF(RIPAK,75)
117 CALL INITF(RNPK,430)
118 CALL INITF(RNCH,75)
119 CALL INITF(RMCH,75)
120 CALL INITF(RIPA,75)
121 CALL INITF(RNP,450)
122 C.....RHPK
123 C
124 CALL INITF(HID,75)
125 CALL INITF(HC,75)
126 CALL INITF(HMO,75)
127 CALL INITF(HTYPE,1125)
128 CALL INITF(HNURQ,375)
129 CALL INITF(HNUAV,75)
130 CALL INITF(HPCU,75)
131 CALL INITF(HAAF,75)
132 CALL INITF(HRCUT,75)
133 CALL INITF(HISR,75)
134 C.....RHPK
135 C
136 CALL INITF(EDX,75)
137 CALL INITF(EIM,75)
138 CALL INITF(EID,75)
139 CALL INITF(EIM,75)
140 CALL INITF(EDURX,375)
141 CALL INITF(EFRPH,75)
142 CALL INITF(EVRTX,75)
143 CALL INITF(ENPK,375)
144 CALL INITF(EDUR,375)
145 CALL INITF(EFRPH,75)
146 CALL INITF(EVRT,75)
147 CALL INITF(EMP,375)
148 C.....RHPK
149 C
150 CALL INITF(FID,25)

DATE: 04/25/77
TIME: 10.12.55
PAGE: 8

PROGRAM AIDE
MDL 4 SPOLLER02

151 CALL INITF(FTYPE,375)
152 CALL INITF(FCCPU,25)

DATE: 04/25/77
TIME: 10.13.01
PROGRAM AIDE
MDL 5 SPOLLER03
PAGE 9

1 CALL INITF(FNURQ,125)
2 CALL INITF(FNUAV,25)
3 CRHPK
4 C
5 CALL INITI(GIDX,25)
6 CALL INITI(GIMX,25)
7 CALL INITI(GID,25)
8 CALL INITI(GIM,25)
9 CALL INITF(GSFEX,25)
10 CALL INITF(GMPSFX,25)
11 CALL INITF(GNFX,125)
12 CALL INITF(GSPF,25)
13 CALL INITF(GMPSF,25)
14 CALL INITF(GNP,125)
15 CRHPK
16 C
17 CALL INITI(API,3)
18 CALL INITI(AIM,3)
19 CALL INITF(AFPC,3)
20 CALL INITF(AVMP,3)
21 CALL INITF(AVMDY,3)
22 CALL INITF(ANP,18)
23 CRHPK
24 C
25 CALL INITF(BSC,5)
26 CRHPK
27 C
28 CALL INITF(CFLAG,30)
29 CRHPK
30 C
31 CRHPK
32 C
33 C *** MAIN CONTROL PROGRAM ***
34 CRHPK
35 C
36 C READ INPUT DATA(MAY BE OUT OF SORT), PRINT IT, WRITE IT ON UNIT 9.
37 C
38 10000 READ(5,10010)ITYPE,CARD
39 10010 FORMAT(12,39A2)
40 IF(ITYPE.NE.U)GO TO 10011
41 NTOTCO = NTOTCO+1
42 C HEADING CARD. REPLACE DEFAULT TITLE.
43 DO 10015 I=1,39
44 TITLE(I) = CARD(I)
45 10015 CONTINUE
46 NITYPE(I) = NITYPE(I)+1
47 10011 CONTINUE
48 IF(NLINES.GE.LPP.OR.NLINES.EQ.0) CALL TITLE1
49 WRITE(6,10020)NTOTCO,ITYPE,CARD
50 10020 FORMAT(5X,13,1H,,3X,12,39A2)

DATE: 04/25/77
LINE: 10,13,01

PROGRAM AIDE
MDL 5 SPOLLER01

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51  NLINES = NLINES+1
52  C 99 IN COLS. 1-2 IS END-OF-DATA FLAG.
53  IF(IITYPE.GT. 50)GO TO 11000
54  C CHECK FOR ILLEGAL CARD TYPE. LEGAL RANGE IS 01-NTYPES.
55  10025 CONTINUE
56  IF(IITYPE .GE. 1 .AND. IITYPE .LE. NTYPES) GO TO 10030
57  CALL ERROR(1,NTOTCD,NTYPES)
58  GO TO 10000
59  10030 NCARDS = NCARDS+1
60  IF(IITYPE .NE. 0) NITYPE(IITYPE) = NITYPE(IITYPE)+1
61  ICOTYP(NCARDS) = IITYPE
62  WRITE(6,10040)IITYPE,CARD,NTOTCD
63  10040 FORMAT(I2,39A2,I3)
64  GO TO 10000
65  C *****RHPK
66  C END OF INPUT DATA.
67  C NOW READ IT BACK FROM UNIT 9, WITH APPROPRIATE FORMAT.
68  C
69  11000 NTOTCD = NTOTCD-1
70  REMIND A
71  NLINES = 0
72  DO 11300 I=1,NCARDS
73  IITYPE = ICOTYP(I)
74  GO TO (11010,11020,11030,11040,11050,11060,11070,11080,11090,
75  1,11100,11110,11120,11130,11140,11150,11160),IITYPE
76  C HEADNG CARD. SKIP OVER IT.
77  11010 READ(9,11015)
78  11015 FORMAT(Ix)
79  GO TO 11900
80  C COURSE DURATION AND INSTRUCTOR TRAINING FACTORS CARD
81  11020 CALL OVERLAY(SLREADD,1,0,6HRECALL)
82  GO TO 11900
83  C STUDENT INPUTS
84  11030 CALL OVERLAY(SLREADS,2,0,6HRECALL)
85  GO TO 11900
86  C INSTRUCTOR INPUTS
87  11040 CALL OVERLAY(SLREADT,3,0,6HRECALL)
88  GO TO 11900
89  C COURSEWARE PROCUREMENT INPUTS
90  11050 CALL OVERLAY(SLREADC,4,0,6HRECALL)
91  GO TO 11900
92  C CURRICULUM MANPOWER INPUTS
93  11060 CALL OVERLAY(SLREADR,5,0,6HRECALL)
94  GO TO 11900
95  C MANPOWER PROCUREMENT INPUTS
96  11070 CALL OVERLAY(SLREADH,6,0,6HRECALL)
97  GO TO 11900
98  C HARDWARE MTC MANPOWER INPUTS
99  11080 CALL OVERLAY(SLREADE,7,0,6HRECALL)
100  GO TO 11900

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101 C FACILITY PROCUREMENT INPUTS
102 11090 CALL OVERLAY(5LREADP,9,0,6HRECALL)
103 GO TO 11900
104 C FACILITIES NYC MANPOWER INPUTS
105 11100 CALL OVERLAY(5LREADG,9,0,6HRECALL)
106 GO TO 11900
107 C TRAINING ADMINISTRATIVE BASE OPERS..AND MEDICAL PERSONNEL INPUTS
108 11110 CALL OVERLAY(5LREADA,10,0,6HRECALL)
109 GO TO 11900
110 C COMPUTER SERVICE CHARGES
111 11120 CALL OVERLAY(5LREAD3,11,0,6HRECALL)
112 GO TO 11900
113 C OFF/AIR/CIV DISTRIBUTION OVERRIDES
114 11130 CALL OVERLAY(5LREADO,12,0,6HRECALL)
115 GO TO 11900
116 C MISCELLANEOUS OVERRIDES
117 11140 CALL OVERLAY(5LREADOO,13,0,6HRECALL)
118 GO TO 11900
119 C PAY AND ALLOWANCE OVERRIDES
120 11150 CALL OVERLAY(5LREADP,14,0,6HRECALL)
121 GO TO 11900
122 C LESSON DESCRIPTORS
123 11160 CALL OVERLAY(5LREADM,15,0,6HRECALL)
124 GO TO 11900
125 11900 CONTINUE
126 GO TO 12000
127 12000 CONTINUE
128 C
129 C CHECK REMAINING DATA,ECHO LESSON DESCRIPTORS,ETC.
130 C
131 CALL OVERLAY(5LAIDEA,16,0,6HRECALL)
132 C
133 C COMPUTE COURSE DURATION
134 C
135 CALL OVERLAY(5LAIDEB,17,0,6HRECALL)
136 GO TO 1900
137 C
138 C CHECK FOR VALID COURSE DURATION
139 19000 CONTINUE
140 IF(OGCD.GT. 0.0160 TO 19025
141 C NO LEGAL COURSE DURATION CARD FOUND. TERMINATE JOB.
142 CALL ERROR(42, IDUMMY, IDUMMY)
143 STOP
144 19025 IF(IDEI.GI. 0.160 TO 19050
145 C STUDENT ENTRY INTERVAL = 0. TERMINATE JOB.

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```

1 CALL ERROR(29, IDUMMY, IDUMMY)
2 STOP
3 19050 CONTINUE
4 C
5 C A12 = NO. MRS. IN 12 MOS.
6 C A24 = NO. MRS. IN 24 MOS.
7 A12 = QATDPM*QTHPD*12.
8 A24 = 2.*A12
9 C
10 C IF COURSE DURATION .GE. 20 WEEKS, IFLAG=1. ELSE IFLAG=0.
11 C
12 IFIDGCD .GE. QATDPM*QTHPD*.61) IFLAG=1
13 IFIDGCD .LT. QATDPM*QTHPD*.61) IFLAG=0
14 C
15 IFIDGCD.LE.A24) GO TO 19200
16 C ERROR. GRADUATE COURSE DURATION EXCEEDS 2 YEARS.
17 CALL ERROR(14, IDUM, IDUM)
18 STOP
19 19200 IFIDMCD.LE.A12) GO TO 19300
20 C ERROR. WASHOUT COURSE DURATION EXCEEDS 1 YEAR.
21 CALL ERROR(15, IDUM, IDUM)
22 STOP
23 19300 CONTINUE
24 C
25 C
26 C COMPUTE STUDENT GRADUATES, MAN-YEARS, WASHOUTS FOR YEARS 1-6
27 C (WHERE YEAR 6 MEANS "IN PROGRESS")
28 C
29 IF(NTYPE(S) .EQ. 0) GO TO 14900
30 C
31 CALL SPHASE
32 C
33 C
34 C
35 14900 CONTINUE
36 C
37 C ESTIMATE RESOURCES REQUIRED
38 C
39 CALL AIDEC
40 C
41 C COMPUTE INSTRUCTOR MAN-YEARS IN YEAR 0
42 C
43 C
44 IF(NTYPE(I).EQ.0) GO TO 14975
45 NT=NTYPE(I)
46 DO 14925 K=1,NT
47 IN(1,K)=TSIIC(K)*TMMOB/12.
48 14925 CONTINUE
49 14975 CONTINUE
50 C

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```

51 C *** MOVE PAY FACTORS FROM TABLES TO PAY MATRIX ***
52 C
53 DO 19100 I=1,10
54 PAY(I,1) = OFF(I)
55 19100 CONTINUE
56 PAYAV(1) = OFFAV
57 DO 19200 I=1,9
58 PAY(I,2) = AMN(I)
59 19200 CONTINUE
60 PAYAV(2) = AMNAV
61 DO 19300 I=1,14
62 PAY(I,3) = CGS(I)
63 19300 CONTINUE
64 PAYAV(3) = CGSAV
65 DO 19400 I=1,14
66 PAY(I,4) = CWB(I)
67 19400 CONTINUE
68 PAYAV(4) = CWBAV
69 DO 19500 I=1,20
70 PAY(I,5) = FOR(I)
71 19500 CONTINUE
72 PAYAV(5) = FORAV
73 C
74 C REPLACE WITH OVERRIDE VALUES, IF ANY
75 C
76 IF(NTYPE(P) .EQ. 0) GO TO 18700
77 N = NTYPE(P)
78 DO 18600 K=1,N
79 J = PPJ(K)
80 I = PPG(K)
81 IF(I .GT. 0) GO TO 18550
82 C
83 C OVERRIDE AVERAGE, AND SET ASTERISK
84 XAVFLG(I,J) = STAR
85 PAYAV(J) = PPAF(K)
86 GO TO 18600
87 C
88 C OVERRIDE MATRIX VALUE, AND SET ASTERISK
89 18550 XPELG(I,J) = STAR
90 PAY(I,J) = PPAF(K)
91 18600 CONTINUE
92 18700 CONTINUE
93 C
94 CALL PRINT2(PAY, PAYAV, XPELG, XAVFLG)
95 C
96 C *** OVERRIDE MISC. PROGRAM CONSTANTS WITH INPUT VALUES, IF ANY ***
97 C
98 DO 19100 I=1,30
99 IF(CFLAG(I) .EQ. BLANK) GO TO 19100
100

```

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101 OCONST(I) = OVRID(I)
102 19100 CONTINUE
103 C
104 CALL PRINT1 (CONST, OFLAG)
105 C
106 C *****RMPK
107 C
108 C *** MOVE MANPOWER INPUTS TO CORRESPONDING PROCUREMENT ID POSITIONS ***
109 C
110 C * CURRICULUM *
111 C
112 IF(NTYPE(R) .EQ. 0) GO TO 15900
113 15000 N1 = NTYPE(I)
114 N2 = NTYPE(R)
115 DO 15100 I2=1,N2
116 DO 15100 I1=1,N1
117 IF(RIDX(I2) .NE. CID(I1)) GO TO 15100
118 C MOVE CURRICULUM MANPOWER INPUTS
119 RID(I1) = RIDX(I2)
120 RIM(I1) = RIMX(I2)
121 RMPCH(I1) = RMPCHX(I2)
122 RMPCH(I1) = RMPCHX(I2)
123 RIPA(I1) = RIPA(I2)
124 DO 15090 J=1,6
125 RNP(J,I1) = RNPX(J,I2)
126 15090 CONTINUE
127 15100 CONTINUE
128 15900 CONTINUE
129 C
130 C * HARDWARE *
131 C
132 IF(NTYPE(E) .EQ. 0) GO TO 16900
133 16000 N1 = NTYPE(H)
134 N2 = NTYPE(E)
135 DO 16100 I2=1,N2
136 DO 16100 I1=1,N1
137 IF(EIDX(I2) .NE. HID(I1)) GO TO 16100
138 C MOVE HARDWARE MANPOWER INPUTS
139 EID(I1) = EIDX(I2)
140 EIM(I1) = EIMX(I2)
141 EFRPH(I1) = EFRPHX(I2)
142 EAVRT(I1) = EAVRTX(I2)
143 DO 16090 J=1,5
144 ENP(J,I1) = ENPX(J,I2)
145 EDUR(J,I1) = EDURX(J,I2)
146 16090 CONTINUE
147 16100 CONTINUE
148 16900 CONTINUE
149 C
150 C * FACILITIES *

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151 C IF(NTYPE(G) .EQ. 0) GO TO 17900
152 N1 = NTYPE(F)
153 17000 N2 = NTYPE(G)
154 DO 17100 I2=1,N2
155 DO 17100 I1=1,N1
156 IF(GIDX(I2) .NE. FID(I1)) GO TO 17100
157 C MOVE FACILITY NAMEPOWER INPUTS
158 GID(I1) = GIDX(I2)
159 GIM(I1) = GIMX(I2)
160 GSPFX(I1) = GSPFX(I2)
161 GMPFX(I1) = GMPFX(I2)
162 DO 17090 J=1,5
163 GMP(J,I1) = GMPX(J,I2)
164 17090 CONTINUE
165 17100 CONTINUE
166 C *****RHPK
167 C *****RHPK
168 C *****RHPK
169 17900 CONTINUE
170 CALL OUT1
171 C CALL OUT2
172 C CALL OUT3
173 C CALL OUT4
174 C
175 C
176 C
177 C
178 C
179 C
180 STOP
END

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1  PROGRAM READD
2  C
3  C*****RHPK
4  C*** COURSE DURATION AND INSTRUCTOR TRAINING FACTORS CARD ***
5  C*****RHPK
6  INTEGER DCARD1,DCARD2
7  INTEGER U,D,S,T,C,R,M,E,F,G,A,B,O,OO,P,M
8  INTEGER TT,TPD,TPG
9  COMMON/ALL/ N1TYPE(20),N1TYPE(20),LPP,NLINES,IPAGE,TITLE(39),IFLAG,
10 X U,D,S,T,C,R,M,E,F,G,A,B,O,OO,P,M
11 COMMON/D/ DSCD,DMR,DMCD,DEI
12 COMMON/T/ TT(25),TPD(25),TPG(25),TSIC(25),TM(6,25),TTR(25),
13 X TMOB,TIFTC,TETC
14 COMMON/AIDE1/ TSIR(25),HSPU(75),HLRHU(75),FSPU(25),
15 X CLRC(75),CSPC(75),TPOI
16 C
17 IF(N1TYPE(0) .NE. 0) GO TO 120
18 READ(9,110) TPOI,DMR,DEI,TMOB,TIFTC,TETC,DCARD1
19 110 FORMAT(2X,F5.0,3F4.0,2F5.0,51X,13)
20 GO TO 190
21 C MORE THAN ONE COURSE DURATION CARD. THIS CARD IS IGNORED.
22 120 READ(9,130) DCARD2
23 130 FORMAT(80X,13)
24 CALL ERROR(2,DCARD1,DCARD2)
25 190 N1TYPE(0) = 1
26 RETURN
27 END

```

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```

1  C
2  C *****
3  C *****RHPK
4  C *** STUDENT INPUTS ***
5  C *****RHPK
6  C *****
7  C *****
8  C *****
9  C *****
10 C *****
11 C *****
12 C *****
13 C *****
14 C *****
15 C *****
16 C *****
17 C *****
18 C *****
19 C *****
20 C *****
21 C *****
22 C *****
23 C *****
24 C *****
25 C *****
26 C *****
27 C *****
28 C *****
29 C *****
30 C *****
31 C *****
32 C *****
33 C *****
34 C *****
35 C *****
36 C *****
37 C *****
38 C *****
39 C *****
40 C *****
41 C *****
42 C *****
43 C *****
44 C *****
45 C *****
46 C *****
47 C *****
48 C *****
49 C *****
50 C *****

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PROGRAM READS

```

1  C
2  C *****
3  C *****RHPK
4  C *** STUDENT INPUTS ***
5  C *****RHPK
6  C *****
7  C *****
8  C *****
9  C *****
10 C *****
11 C *****
12 C *****
13 C *****
14 C *****
15 C *****
16 C *****
17 C *****
18 C *****
19 C *****
20 C *****
21 C *****
22 C *****
23 C *****
24 C *****
25 C *****
26 C *****
27 C *****
28 C *****
29 C *****
30 C *****
31 C *****
32 C *****
33 C *****
34 C *****
35 C *****
36 C *****
37 C *****
38 C *****
39 C *****
40 C *****
41 C *****
42 C *****
43 C *****
44 C *****
45 C *****
46 C *****
47 C *****
48 C *****
49 C *****
50 C *****

```

INTEGER SCARD(75)
 INTEGER U,D,S,T,C,R,H,E,F,G,A,B,O,O,P,M
 INTEGER ST,SPD,SPG,SIM
 COMMON/ALL/ N1TYPE(20),N1TYPE(20),LPP,NLINES,IPAGE,TITLE(39),IFLAG,
 X U,D,S,T,C,R,H,E,F,G,A,B,O,O,P,M
 X ST(75),SPD(75),SPG(75),SIM(75),SNGRAD(7,75),
 X SNYRS(7,75),SENTS(7,75),SNMASH(7,75)
 X CLRC(75),CSPC(75),TPOI
 COMMON/AIDE1/ TSIR(25),HSPU(75),HLRHU(75),FSPU(25),
 COMMON/AIDE1A/SVAR(75,3),SVARNH(3),NSVAR

C IF FIRST ENTRY TO SUBROUTINE, INITIALIZE K
 IF(N1TYPE(1) .GT. 0)GO TO 200
 C (K) GETS INCREMENTED FOR EACH ERROR-FREE DATA CARD
 K = 0
 K = K+1
 K1 = K-1
 IF(K .LE. 75)GO TO 205
 C TOO MANY STUDENT INPUTS. OMIT CARD.
 READ(8,203)ICONO
 FORMAT(80X,13)
 CALL ERROR(43,S,ICONO)
 K = K-1
 GO TO 290
 K J=1,5),SCARD(K)
 FORMAT(2X,3I2,3F3.0,5F4.0,43X,13)
 SIM(K)=0
 C *****RHPK
 220 IF(SPD(K) .GE. 1 .AND. SPD(K) .LE. 5)GO TO 225
 C ILLEGAL STUDENT PERSONNEL DESIGNATOR. OMIT CARD.
 CALL ERROR(1,1,DUHMY,SCARD(K))
 K = K-1
 GO TO 290
 225 IF(ST(K) .GE. 1 .AND. ST(K) .LE. 7)GO TO 230
 C ILLEGAL STUDENT TYPE. OMIT CARD.
 CALL ERROR(4,1,DUHMY,SCARD(K))
 K = K-1
 GO TO 290
 C CHECK FOR ILLEGAL PERSONNEL DESIGNATOR-PAY GRADE PAIR
 230 IF(SPD(K) .EQ. 1 .AND. SPG(K) .GE. 0
 .AND. SPG(K) .LE. 10)GO TO 235
 1 IF(SPD(K) .EQ. 2 .AND. SPG(K) .GE. 0
 .AND. SPG(K) .LE. 9)GO TO 235
 1 IF(SPD(K) .EQ. 3 .AND. SPG(K) .GE. 0

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51      1 .AND. SPG(K) .LE. 10160 TO 235
52      IF (SPD(K) .EQ. 4 .AND. SPG(K) .GE. 0
53      1 .AND. SPG(K) .LE. 14160 TO 235
54      IF (SPD(K) .EQ. 5) 60 TO 235
55      C ILLEGAL PAIR FOUND
56      CALL ERROR(26, IDUMMY, SCARD(K))
57      K = K-1
58      GO TO 298
59      C CHECK FOR DUPLICATE STUDENT TYPE-PERS. DESIGNATOR-PAY GRADE
60      235 IF (K .EQ. 1) 60 TO 250
61      DO 240 I=1, K1
62      IF (ST(K) .EQ. ST(I) .AND. SPD(K) .EQ. SPD(I)
63      1 .AND. SPG(K) .EQ. SPG(I) .AND. SVAR(K,1) .EQ. SVAR(I,1)
64      2 .AND. SVAR(K,2) .EQ. SVAR(I,2) .AND. SVAR(K,3) .EQ. SVAR(I,3) )
65      3 GO TO 245
66      240 CONTINUE
67      GO TO 250
68      C DUPLICATE FOUND. OMIT CARD.
69      245 CALL ERROR(5, SCARD(I), SCARD(K))
70      K = K-1
71      GO TO 298
72      250 IF (SIM(K) .EQ. 0 .OR. SIM(K) .EQ. 1) 60 TO 260
73      C ILLEGAL VALUE IN STUDENT INPUT METHOD. OMIT CARD.
74      CALL ERROR(31, IDUMMY, SCARD(K))
75      K = K-1
76      GO TO 298
77      C MAKE SURE THAT IF ST=7 THEN SPD=5, AND VICE VERSA (FOREIGN STUDENT)
78      260 IF (ST(K) .EQ. 7 .AND. SPD(K) .EQ. 5) .OR.
79      1 (ST(K) .NE. 7 .AND. SPD(K) .NE. 5) GO TO 290
80      CALL ERROR(39, IDUMMY, SCARD(K))
81      K = K-1
82      GO TO 290
83      C*****RHPK
84      290 NTYPE(S) = K
85      C ROUND AND TRUNCATE ENTRANTS, NO. GRADS.
86      DO 295 J=1, 6
87      SENTS(J, K) = ROUND(SENTS(J, K))
88      SNGRAD(J, K) = ROUND(SNGRAD(J, K))
89      295 CONTINUE
90      C
91      RETURN
92      END

```


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```

1 C
2 C .....RHPK
3 C *** INSTRUCTOR INPUTS ***
4 C .....RHPK
5 C .....RHPK
6
7 INTEGER TCARD(25)
8 INTEGER U,D,S,T,C,R,H,E,F,G,A,B,O,OO,P,M
9 INTEGER TT,TPD,TPG
10 COMMON/ALL/ NTYPE(20),NTYPE(20),LPP,NLINES,IPAGE,TITLE(39),IFLAG,
11      X U,O,S,T,C,R,H,E,F,G,A,B,O,OO,P,M
12      X TT(25),TPD(25),TPG(25),TSIIC(25),TM(6,25),TTR(25),
13      X TMOB,TIFTC,TETC
14      X COMMON/AIDE1/ TSIR(25),HSPU(75),HLRHU(75),FSPU(25),
15      X CLRC(75),CSPC(75),TPOI
16
17 C IF FIRST ENTRY TO SUBROUTINE, INITIALIZE K
18 C IF(NTYPE(T)) .GT. 0)GO TO 300
19 C (K) GETS INCREMENTED FOR EACH ERROR-FREE DATA CARD)
20 K = 0
21 K = K+1
22 K1 = K-1
23 IF(K .LE. 25)GO TO 305
24 IF(K .LE. 25)GO TO 305
25 C TOO MANY INSTRUCTOR INPUTS. OMIT CARD.
26 READ(4,303)ICDNO
27 C
28 C
29 C
30 C
31 C
32 C .....RHPK
33 C
34 C ILLEGAL INSTRUCTOR PERSONNEL DESIGNATOR. OMIT CARD.
35 CALL ERROR(6,IOUMMY,TCARD(K))
36 K = K-1
37 GO TO 390
38 C CHECK FOR ILLEGAL PERSONNEL DESIGNATOR-PAY GRADE PAIR
39 315 IF(TPD(K) .EQ. 1 .AND. TPG(K) .GE. 0
40      1 .AND. TPG(K) .LE. 10)GO TO 320
41 IF(TPD(K) .EQ. 2 .AND. TPG(K) .GE. 0
42      1 .AND. TPG(K) .LE. 9)GO TO 320
43 IF(TPD(K) .EQ. 3 .AND. TPG(K) .GE. 0
44      1 .AND. TPG(K) .LE. 10)GO TO 320
45 IF(TPD(K) .EQ. 4 .AND. TPG(K) .GE. 0
46      1 .AND. TPG(K) .LE. 14)GO TO 320
47 C ILLEGAL PAIR FOUND
48 CALL ERROR(27,IOUMMY,TCARD(K))
49 K = K-1
50 GO TO 390

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51 C CHECK FOR DUPLICATE INSTRUCTOR TYPE-PERSONNEL DESIGNATOR-PAY GRADE
52 320 IF(K .EQ. 1)GO TO 350
53 DO 330 I=1,K1
54 IF(TT(K) .EQ. TT(I) .AND. TPO(K) .EQ. TPO(I)
55 1 .AND. TPG(K) .EQ. TPG(I) .AND. TSIR(K) .EQ. TSIR(I) )
56 2 GO TO 340
57 330 CONTINUE
58 GO TO 350
59 C DUPLICATE FOUND. OMIT CARD.
60 340 CALL ERROR(7,TCARD(I),TCARD(K))
61 K = K-1
62 GO TO 390
63 350 IF(TT(K) .EQ. 0 .OR. TT(K) .EQ. 9)GO TO 390
64 C ILLEGAL INSTRUCTOR TYPE. OMIT CARD.
65 CALL ERROR(32,IDUMMY,TCARD(K))
66 K = K-1
67 GO TO 390
68 C.....*****RHPX
69 390 NTYPE(I) = K
70 RETURN
71 END

```

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PROGRAM AIDE
MDL 12 READC

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1  PROGRAM READC
2  C
3  C *****RHPK
4  C *** COURSEWARE PROCUREMENT INPUTS ***
5  C *****RHPK
6  C
7  INTEGER CCARD(75)
8  INTEGER U,O,S,T,C,R,M,E,F,G,A,B,O,OO,P,M
9  COMMON/ALL/ NITYPE(20),NITYPE(20),LPP,NLINES,IPAGE,TITLE(39),IFLAG,
10 X U,O,S,T,C,R,M,E,F,G,A,B,O,OO,P,M
11 X CIO(75),CC(75),CTYPE(11,75),CCOPY(12,75),CMEAS(3,75),
12 X CNURQ(15,75),CNMU(75),CIPCM(75),CCCM(75),CPC(75),
13 X CARV(75),CARP(75)
14 X COMMON/AIDE1/ TSIR(25),HSPU(75),HLRHU(75),FSPU(25),
15 X CLRC(75),CSPC(75),TPOI
16
17 C IF FIRST ENTRY TO SUBROUTINE, INITIALIZE K
18 IF(NITYPE(C) .GT. 0)GO TO 400
19 C (K) GETS INCREMENTED FOR EACH ERROR-FREE DATA CARD
20 K = 0
21 400 K = K+1
22 IF(K .LE. 75)GO TO 405
23 IF(K .LE. 75)GO TO 405
24 C 100 MANY COURSEWARE PROCUREMENT INPUTS. OMIT CARD.
25 READ(9,403)ICDNO
26 403 FORMAT(80X,I3)
27 CALL ERROR(43,C,ICDNO)
28 K = K-1
29 GO TO 490
30 405 READ(9,410) CIO(K),CC(K),CTYPE(J,K),J=1,11),CCOPY(J,K),J=
31 X 1,2),CMEAS(J,K),J=1,3),CNMU(K),CIPCM(K),CCCM(K),CPC(K),
32 X CARV(K),CARP(K),CLRC(K),CSPC(K),CCARD(K)
33 410 FORMAT(2X,I2,I1,I1,I2,2A2,3A2,F4.0,F5.0,2F5.0,4F3.0,14X,I3)
34 C *****RHPK
35 IF(CLRC(K) .EQ. 0.0) CLRC(K)=1.0
36 IF(CSPC(K) .EQ. 0.0) CSPC(K)=1.0
37 IF(CIO(K) .GT. 0)GO TO 420
38 C COURSEWARE ID IS 0,BLANK,OR NEGATIVE. OMIT CARD.
39 CALL ERROR(19,1DUMMY,CCARD(K))
40 K = K-1
41 GO TO 490
42 C CHECK FOR DUPLICATE COURSEWARE ID
43 420 IF(K .EQ. 1)GO TO 450
44 DO 430 I=1,K1
45 IF(CIO(I) .EQ. CIO(I))GO TO 440
46 430 CONTINUE
47 GO TO 450
48 C DUPLICATE FOUND. OMIT CARD.
49 440 CALL ERROR(19,CCARD(I),CCARD(K))
50 K = K-1

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51 GO TO 490
52 IF (CCIK) .GE. 1 .AND. CCIK) .LE. 4360 TO 490
53 C ILLEGAL COURSEWARE SUB-CLASS. OMIT CARD.
54 CALL ERROR(33, IDUMMY, CCARD(K))
55 K = K-1
56 GO TO 490
57 C .....RHPK
58 490 NTYPE(C) = K
59 C ROUND AND TRUNCATE NO. UNITS REQUIRED
60 DO 495 J=1,5
61 CNUR(J,K) = ROUND(CNUR(J,K))
62 CONTINUE
63 RETURN
64 END

```



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TIME: 10.13.13         SHARED      HDL 13 READS

1  PROGRAM READR
2  C .....
3  C .....
4  C *** CURRICULUM MANPOWER INPUTS ***
5  C .....
6  C .....
7  C .....
8  C .....
9  C .....
10 C .....
11 C .....
12 C .....
13 C .....
14 C .....
15 C IF FIRST ENTRY TO SUBROUTINE, INITIALIZE K
16 C IF (NTYPE(1) .GT. 0) GO TO 500
17 C (K) GETS INCREMENTED FOR EACH ERROR-FREE DATA CARD
18 K = 0
19 500 K = K+1
20 K1 = K-1
21 IF (K .LE. 75) GO TO 505
22 C TOO MANY CURRICULUM MANPOWER INPUTS. OMIT CARD.
23 READ(4,503) ICONO
24 503 FORMAT(80X,I3)
25 CALL ERROR(43,R,ICONO)
26 K = K-1
27 GO TO 500
28 505 READ(4,510) RIDX(K),RNCHX(K),RMPCHX(K),RIPAX(K),RCARD(K)
29 510 FORMAT(2X,I2,F5.0,F3.0,63X,I3)
30 RNCHX(K)=1
31 C .....
32 IF (RIDX(K) .GT. 0) GO TO 520
33 C COURSEWARE ID IS 0, BLANK, OR NEGATIVE. OMIT CARD.
34 CALL ERROR(10,IOUJMY,RCARD(K))
35 K = K-1
36 GO TO 500
37 C CHECK FOR DUPLICATE COURSEWARE ID
38 520 IF (K .EQ. 1) GO TO 550
39 DO 530 I=1,K1
40 IF (RIDX(I) .EQ. RIDX(K)) GO TO 540
41 530 CONTINUE
42 GO TO 550
43 C DUPLICATE FOUND. OMIT CARD.
44 540 CALL ERROR(11,RCARD(I),RCARD(K))
45 K = K-1
46 GO TO 500
47 550 IF (RNCHX(K) .EQ. 1 .OR. RNCHX(K) .EQ. 2) GO TO 590
48 C ILLEGAL VALUE FOR INPUT METHOD. MUST EQUAL 01,02. OMIT CARD.
49 CALL ERROR(34,IOUJMY,RCARD(K))
50 K = K-1
51 GO TO 590
52 C .....
53 590 NTYPE(2) = K
54 RETURN
55 END

```

MDC E1570
15 MAY 1977

MCDONNELL DOUGLAS ASTRONAUTICS COMPANY - EAST

EVALUATING INSTRUCTIONAL SYSTEMS

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```

DATE: 04/25/77          PROGRAM ATOE
LINE: 10111111          SHARED      MOL 14 REACH          PAGE 25
51 C ILLEGAL HARDWARE SUB-CLASS. OMIT CARD.
52 CALL ERROR(15, IUMMY, HCARD(K))
53 K = K-1
54 GO TO 690
55 IF (HOD(K)) .EQ. 0 .OR. HOD(K) .EQ. 1 GO TO 690
56 C ILLEGAL DEMAND OPTION. OMIT CARD.
57 CALL ERROR(10, IUMMY, HCARD(K))
58 K = K-1
59 GO TO 690
60 C *****RMPK
61 590 NTYPE(H) = K
62 C 90ND AND TRUNCATE NO. UNITS REQUIRED
63 DO 695 J=1,5
64 MNURO(J,K) = ROUND0(MNURO(J,K))
65 635 CONTINUE
66 IF (HOD(K)) .EQ. 1 .AND. HPCJ(K) .GE. 1000.) HOD(K) = 0
67 RETURN
68 END

```

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```

51      GO TO 790
52      C .....
53      790  NTYPE(E) = K
54      RETURN
55      END
.....RMPX

```


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DATE: 04/25/77
LINE: 10,13,45
PROGRAM AIDE
SHARED
MDL 16 READ
PAGE 29

```

1  C
2  C *****
3  C *****
4  C *** FACILITY PROCUREMENT INPUTS ***
5  C *****
6  C *****
7  C *****
8  C *****
9  C *****
10 C *****
11 C *****
12 C *****
13 C *****
14 C *****
15 C *****
16 C *****
17 C *****
18 C *****
19 C *****
20 C *****
21 C *****
22 C *****
23 C *****
24 C *****
25 C *****
26 C *****
27 C *****
28 C *****
29 C *****
30 C *****
31 C *****
32 C *****
33 C *****
34 C *****
35 C *****
36 C *****
37 C *****
38 C *****
39 C *****
40 C *****
41 C *****
42 C *****
43 C *****
44 C *****
45 C *****
46 C *****
47 C *****
48 C *****
49 C *****
50 C *****

```

DATE: 04/25/77
LINE: 10,13,45
PROGRAM AIDE
SHARED
MDL 16 READ
PAGE 30

```

51 C *****
52 C *****
53 C *****
54 C *****
55 C *****
56 C *****
57 C *****
58 C *****
59 C *****
60 C *****

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MDC E1570
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```

51      GO TO 990
52      C .....
53      990  NTYPE(G) = K
54      RETURN
55      END

```

EVALUATING INSTRUCTIONAL SYSTEMS

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MDC E1570
15 MAY 1977

```

DATE: 04/25/77          PROGRAM AIDE          PAGE 11
TIME: 10.13.50          SHARED          MDL 20 READA

1  PROGRAM READA
2  C
3  C *****RHPK
4  C *** TRAINING ADMIN.,BASE OP., SUPPORT AND MEDICAL PERSONNEL INPUTS ***
5  C *****RHPK
6  C
7  INTEGER ACARD(3)
8  INTEGER U,D,S,I,C,R,H,E,F,G,A,B,O,OO,P,M
9  INTEGER APT,AIM
10 COMMON/ALL/ NITYPE(20),NTYPE(20),LPP,NLINES,IPAGE,TITLE(39),IFLAG,
11 X U,D,S,I,C,R,H,E,F,G,A,B,O,OO,P,M
12 COMMON/A/ APT(3),AIM(3),AFMPC(3),AVMPCS(3),AVMTDY(3),ANP(6,3)
13 C
14 C IF FIRST ENTRY TO SUBROUTINE, INITIALIZE K
15 C IF NITYPE(1) .GT. 0 GO TO 1000
16 C (K) GETS INCREMENTED FOR EACH ERROR-FREE DATA CARD)
17 K = 0
18 1000 K = K+1
19 K1 = K-1
20 IF (K .LE. 3) GO TO 1005
21 C MORE THAN 3 TYPE-A CARDS. OMIT THIS CARD.
22 READ(9,1003)ICDNO
23 1003 FORMAT(50X,I3)
24 CALL ERROR(43,A,ICDNO)
25 K=K-1
26 GO TO 1090
27 1005 READ(9,1010) APT(K),AIM(K),AFMPC(K),AVMPCS(K),AVMTDY(K),
28 1 (ANP(J,K),J=1,6),ACARD(K)
29 1010 FORMAT( 2X,I21,3F5.0,6F5.0,29X,I3)
30 C *****RHPK
31 IF (APT(K) .GE. 13 .AND. APT(K) .LE. 15) GO TO 1020
32 C INVALID PERSONNEL TYPE. OMIT CARD.
33 CALL ERROR(20,IOUIMY,ACARD(K))
34 K = K-1
35 GO TO 1090
36 C CHECK FOR DUPLICATE PERSONNEL TYPE
37 1020 IF (K .EQ. 1) GO TO 1050
38 DO 1030 I=1,K1
39 IF (APT(I) .EQ. APT(1)) GO TO 1040
40 CONTINUE
41 GO TO 1050
42 C DUPLICATE FOUND. OMIT CARD.
43 CALL ERROR(21,ACARD(I),ACARD(K))
44 K = K-1
45 GO TO 1090
46 1050 IF (AIM(K) .EQ. 1 .OR. AIM(K) .EQ. 2) GO TO 1090
47 C ILLEGAL VALUE FOR INPUT METHOD. MUST EQUAL 1 OR 2. OMIT CARD.
48 CALL ERROR(39,IOUIMY,ACARD(K))
49 K = K-1
50 GO TO 1090
51 C *****RHPK
52
53

```

```

DATE: 04/25/77          PROGRAM AIDE          PAGE 11
TIME: 10.13.50          SHARED          MDL 20 READA

51 1090 NITYPE(A) = K
52 RETURN
53 END

```


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```

DATE: 04/25/77
LINE: 10,11,51
PROGRAM AIDE
SHARED MDL 21 READQ PAGE 10
51 OFLAG(12) = BLANK
52 OFLAG(13) = BLANK
53 IF(IERR.EQ.0)CALL ERROR(30,OCARD1,10UMHY)
54 IERR = 1
55 1315 CONTINUE
56 GO TO 1390
57 C MORE THAN ONE OFF/AIR/CIV OVERRIDE CARD. THIS CARD IS IGNORED.
58 1320 READ(5,1330) OCARD2
59 1330 FORMAT(60X,13)
60 CALL ERROR(25,OCARD1,OCARD2)
61 1390 NTYPE(0) = 1
62 RETURN
63 END

```

MDC E1570
15 MAY 1977

MCDONNELL DOUGLAS ASTRONAUTICS COMPANY - EAST

DATE 04/25/77 PROGRAM AIDE
TIME 10.13.59 SHARED MOL 23 READP PAGE 18

```

1  PROGRAM READP
2  C *****
3  C *****
4  C *** PAY AND ALLOWANCE OVERRIDES ***
5  C *****
6  C *****
7  C *****
8  C *****
9  C *****
10 C *****
11 C *****
12 C *****
13 C *****
14 C *****
15 C *****
16 C *****
17 C *****
18 C *****
19 C *****
20 C *****
21 C *****
22 C *****
23 C *****
24 C *****
25 C *****
26 C *****
27 C *****
28 C *****
29 C *****
30 C *****
31 C *****
32 C *****
33 C *****
34 C *****
35 C *****
36 C *****
37 C *****
38 C *****
39 C *****
40 C *****
41 C *****
42 C *****
43 C *****
44 C *****
45 C *****
46 C *****
47 C *****
48 C *****
49 C *****
50 C *****

```

10 U,0,S,T,C,R,M,E,F,G,A,9,0,00,P,M
 11 COMMON/P/ PPD(75),PPG(75),PPAF(75)
 12 C IF FIRST ENTRY TO SUBROUTINE, INITIALIZE K
 13 IF (NTYPE(1) .GT. 0) GO TO 1200
 14 K = 0
 15 K = 0
 16 K = 0
 17 K = 0
 18 K = 0
 19 K = 0
 20 K = 0
 21 K = 0
 22 K = 0
 23 K = 0
 24 K = 0
 25 K = 0
 26 K = 0
 27 K = 0
 28 K = 0
 29 K = 0
 30 K = 0
 31 K = 0
 32 K = 0
 33 K = 0
 34 K = 0
 35 K = 0
 36 K = 0
 37 K = 0
 38 K = 0
 39 K = 0
 40 K = 0
 41 K = 0
 42 K = 0
 43 K = 0
 44 K = 0
 45 K = 0
 46 K = 0
 47 K = 0
 48 K = 0
 49 K = 0
 50 K = 0

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DATE: 04/25/77      PROGRAM AIDE      PAGE 19
LINE: 10,13,59      SHARED      MDL 23 READP

51      00 1230 I=1,K1
52      IF (PPD(K) .EQ. PPD(I) .AND. PPG(K) .EQ. PPG(I)) GO TO 1240
53      1230 CONTINUE
54      GO TO 1290
55      C DUPLICATE FOUND. OMIT CARD.
56      1240 CALL ERROR(24,PCARD(I),PCARD(K))
57      K = K-1
58      GO TO 1290
59      C *****RMPK
60      1290 NTYPE(P) = K
61      RETURN
62      END

```



```

DATE 04/25/77      PROGRAM AIDE      PAGE 40
TIME 10.15.02      SHARED      MDL 24 PRINT1
SUBROUTINE PRINT1(QCONST,OFLAG)
1  C
2  C
3  C
4  C
5  C
6  C
7  C
8  C
9  C
10 C
11 C
12 C
13 C
14 C
15 C
16 C
17 C
18 C
19 C
20 C
21 C
22 C
23 C
24 C
25 C
26 C
27 C
28 C
29 C
30 C
31 C
32 C
33 C
34 C
35 C
36 C
37 C
38 C
39 C
40 C
41 C
42 C
43 C
44 C
45 C
46 C
47 C
48 C
49 C
50 C

      DIMENSION QCONST(30), OFLAG(30)
      DATA STAR/1H*/
      CALL HEAD
      WRITE(6,6010)
      FORMAT(1H0,42X,25H PROGRAM CONSTANTS /17X,8(2H==),1H=/1X/
2  28X,42H OFFICER/AIRMAN/CIVILIAN DISTRIBUTION ,
4  36X,10MCURRICULUM )
      WRITE(6,6020) (QCONST(I), OFLAG(I), I=1,3)
      FORMAT(40X,3HOFF,37X,F4.0,1X,A1 /
1  40X,3HAMN,37X,F4.0,1X,A1 /
2  40X,3MCIV,37X,F4.0,1X,A1 )
      WRITE(6,6030)
      FORMAT(1H0,35X,8HARDWARE )
      WRITE(6,6040) (QCONST(I), OFLAG(I), I=4,6)
      WRITE(6,6050)
      FORMAT(1H0,35X,9HACILITY )
      WRITE(6,6060) (QCONST(I), OFLAG(I), I=7,9)
      WRITE(6,6070)
      FORMAT(1H0,35X,23HTRAINING ADMINISTRATIVE )
      WRITE(6,6080) (QCONST(I), OFLAG(I), I=10,12)
      WRITE(6,6090)
      FORMAT(1H0,35X,15HBASE OPERATIONS )
      WRITE(6,6100) (QCONST(I), OFLAG(I), I=13,15)
      WRITE(6,6110)
      FORMAT(1H0,35X,7HMEDICAL )
      WRITE(6,6120) (QCONST(I), OFLAG(I), I=16,18)
      WRITE(6,6130)
      FORMAT(1H0,27X,42H AVAILABLE PRODUCTIVE MAN-HOURS/MONTH /
1  34X,14H HARDWARE MTC,31X,F5.0,1X,A1 /
2  34X,12H ALL OTHERS,33X,F5.0,1X,A1 /1X/
3  28X,33H AVERAGE TRAINING DAYS/MONTH ,18X,F6.1,
4  1X,A1 / 1X /
5  28X,45H AVERAGE CLASSROOM TRAINING HRS/STUDENT/DAY,
6  6X,F5.0,1X,A1 / 1X /

```



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DATE: 04/25/77          PROGRAM AIOE          PAGE 42
TIME: 10.14.05          SHARED          MDL 25 PRINT2
1  C      SUBROUTINE PRINT2( PAY, PAYAV, XPFLG, XAVFLG)
2  C      .....
3  C      .....
4  C      PRINT PAY FACTOR TABLES AND OVERRIDES ***
5  C      .....
6  C      .....
7  C      DIMENSION PAY(20,5), PAYAV(5), XPFLG(20,5), XAVFLG(5)
8  C      .....
9  C      CALL HEAD
10 C      .....
11 C      WRITE(6,5010)
12 C      FORMAT(140, 38X, 34M ANNUAL PAY RATES (FY 1975) /
13 1 43X, 13(24=) / 1X / 1X /
14 2 3X, 22M MILITARY PERSONNEL ,
15 3 13X, 22M CIVILIAN PERSONNEL ,
16 4 14X, 20M FOREIGN STUDENTS /
17 5 1X /
18 6 13X, 3HPAY, 4X, 6ANNUAL, 22X, 3MPAY, 5X, 6ANNUAL,
19 7 22X, 3HPAY, 4X, 6ANNUAL, /
20 8 12X, 5HGRADE, 4X, 4HRA, 22X, 5HGRADE, 5X, 4HRA,
21 9 22X, 5HGRADE, 4X, 4HRA, /
22 X 12X, 5H-----, 3X, 6M-----, 21X, 5H-----, 4X, 6M-----,
23 X 21X, 5H-----, 3X, 6M----- )
24 C      WRITE(6,5015) PAY(1,1), XPFLG(1,1), PAY(1,3), XPFLG(1,3),
25 1 PAY(1,5), XPFLG(1,5)
26 1 FORMAT(12X, 4MO- 1 $, F6.0, 1X, A1,
27 1 13X, 9MGS- 1 $, F6.0, 1X, A1,
28 2 13X, 8MF- 1 $, F6.0, 1X, A1 )
29 C      .....
30 C      WRITE(6,5020) (I, PAY(I,1), XPFLG(I,1),
31 1 PAY(I,3), XPFLG(I,3),
32 2 I, PAY(I,5), XPFLG(I,5), I=1,13 )
33 2 FORMAT(12X, 4MO- 1 $, F6.0, 1X, A1,
34 1 13X, 9MGS- 1 $, F6.0, 1X, A1,
35 2 13X, 8MF- 1 $, F6.0, 1X, A1 )
36 C      .....
37 C      WRITE(6,5030) PAYAV(1), XAVFLG(1),
38 1 (I, PAY(I,3), XPFLG(I,3),
39 2 I, PAY(I,5), XPFLG(I,5), I=1,13 )
40 2 FORMAT(12X, 6MO-AVG., 2X, F6.0, 1X, A1,
41 1 13X, 9MGS- 12, 4X, F6.0, 1X, A1,
42 2 19X, 2MF- 12, 4X, F6.0, 1X, A1 /
43 3 47X, 3MGS- 12, 4X, F6.0, 1X, A1,
44 4 19X, 2MF- 12, 4X, F6.0, 1X, A1 /
45 5 47X, 3MGS- 12, 4X, F6.0, 1X, A1,
46 6 19X, 2MF- 12, 4X, F6.0, 1X, A1 )
47 C      .....
48 C      DO 5040 I=1,5
49 1 I3 = I+13
50

```

DATE: 8-25-77
TIME: 10:14:05
PROGRAM AIDE
MDL 25 PRINT2
PAGE 43

```

51 WRITE(6,5050) I, PAY(I,2), XPFLG(I,2),
52 I13, PAY(I13,3), XPFLG(I13,3),
53 I13, PAY(I13,5), XPFLG(I13,5)
54 5060 CONTINUE
55 5050 FORMAT(12X, 2HE-, 12, 4X, F6.0, 1X, A1,
56 19X, 3HGS-, 12, 4X, F6.0, 1X, A1,
57 19X, 2HF-, 12, 4X, F6.0, 1X, A1 )
58 C
59 WRITE(6,5060) PAY(6,2), XPFLG(6,2),
60 PAV(3), XAVFLG(3),
61 PAV(19,5), XPFLG(19,5),
62 PAV(7,2), XPFLG(7,2),
63 PAV(20,5), XPFLG(20,5),
64 PAV(8,2), XPFLG(8,2),
65 PAV(5), XAVFLG(5),
66 PAV(9,2), XPFLG(9,2),
67 PAV(1,4), XPFLG(1,4),
68 PAV(12), XAVFLG(2),
69 PAV(2,4), XPFLG(2,4)
70 5060 FORMAT(12X, 4HE- 6, 4X, F6.0, 1X, A1,
71 19X, 7HGS-AVG., 2X, F6.0, 1X, A1,
72 19X, 4HF-19, 4X, F6.0, 1X, A1 /
73 12X, 4HE- 7, 4X, F6.0, 1X, A1,
74 55X, 4HF-20, 4X, F6.0, 1X, A1 /
75 12X, 4HE- 8, 4X, F6.0, 1X, A1,
76 55X, 6HF-AVG., 2X, F6.0, 1X, A1 /
77 12X, 4HE- 9, 4X, F6.0, 1X, A1,
78 19X, 5HMB- 1, 4X, F6.0, 1X, A1 /
79 12X, 6HE-AVG., 2X, F6.0, 1X, A1,
80 19X, 5HMB- 2, 4X, F6.0, 1X, A1 )
81 C
82 WRITE(6,5070) (I, PAY(I,4), XPFLG(I,4), I=3,14)
83 5070 FORMAT( 47X, 3HMB-, 12, 4X, F6.0, 1X, A1 )
84 C
85 WRITE(6,5080) PAV(4), XAVFLG(4)
86 5080 FORMAT( 47X, 7HMB-AVG., 2X, F6.0, 1X, A1 )
87 C
88 WRITE(6,5090)
89 5090 FORMAT( 5(1X/), 3X, 40H* INDICATES USER OVERRIDE VALUE (IF ANY))
90 C
91 RETURN
92 END

```


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VOLUME II

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DATE 04/25/77          PROGRAM AIDE          PAGE 44
TIME 10.14.09          SHARED          VOL 26 SPMSE
1 SUBROUTINE SPMSE
2 C
3 C *****RMPK
4 C *** SPMSE -- TIME PHASED GRADUATE MAN-YEAR CALCULATIONS ***
5 C *****RMPK
6 C
7 C INTEGER U,D,S,T,C,R,H,E,F,G,A,9,0,00,P,M
8 C INTEGER ST,SPD,SPG,SIM
9 C COMMON/ALL/ NTYPE(20),LPP,NLINES,IPAGE,TITLE(39),IFLAG,
10 C U,D,S,T,C,R,H,E,F,G,A,9,0,00,P,M
11 C COMMON/O/ DGC0,DMR,DMCD,DEI
12 C COMMON/S/ ST(75),SPD(75),SPG(75),SIM(75),SNMASH(7,75),
13 C SMYRS(7,75),SENTS(7,75),QHOFF,QHAMN,QHCIV,
14 C QCOFF,QCAMN,QCCIV, QHOFF,QHAMN,QHCIV,
15 C QCOFF,QCAMN,QCCIV, QHOFF,QHAMN,QHCIV,
16 C QCOFF,QCAMN,QCCIV, QHOFF,QHAMN,QHCIV,
17 C QHAMPH,QCAMPH,QATOPH,QTHPO,QHSCPH,QCPHOF,QCPHAM,QCPHCV,
18 C QTDYTC,QTDYOF,QTDYAM,QTDYCV
19 C DIMENSION GRATE(7),FRATE(7),GRADS(7,7),WASH(7,7),COMPLT(7),FAIL(7)
20 C
21 C A12=NO. HRS. IN 12 MOS.
22 C A24=NO. HRS. IN 24 MOS.
23 C A12=(12.*QATOPH)*QTHPO
24 C A24=(24.*QATOPH)*QTHPO
25 C IF(DGC0.GT.A12)GO TO 2000
26 C *****RMPK
27 C
28 C COURSE DURATION <= 12 MONTHS
29 C
30 C NS = NTYPE(S)
31 C DO 1000 K=1,NS
32 C =====
33 C
34 C CALL INITF(GRATE,7)
35 C CALL INITF(FRATE,7)
36 C CALL INITF(GRAOS,49)
37 C CALL INITF(WASH,49)
38 C
39 C GRAD. RATE, FAIL. RATE, FOR STUDENTS ENTERING IN YEAR I (PER MO.)
40 C
41 C DO 10 I=1,5
42 C COMPL(I) = ROUND(SENTS(I,K)/(1.-DMR/100.))
43 C FAIL(I) = SENTS(I,K)-COMPL(I)
44 C GRATE(I)=COMPL(I)/(A12/DEI)
45 C FRATE(I)=SENTS(I,K)/(A12/DEI)-GRATE(I)
46 C
47 C 10 CONTINUE
48 C
49 C NO. OF YEAR I ENTRANTS GRADUATING IN YEAR J(J=I,I+1)
50 C

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DATE: 04/25/77
TIME: 10:14:09
PROGRAM AIDE
PAGE 45

51 DO 20 I=1,5
52 I1=I+1
53 DO 20 J=I, I1
54 IF (J.EQ.I) GRADS(I,J)=ROUND(IGRATE(I) * AINT(A12/DEI+1.-DGCD/DEI))
55 IF (J.EQ.I+1) GRADS(I,J)=COMPL(I) - GRADS(I,I)
56 CONTINUE
57 C
58 C TOTAL NO. GRADUATES IN YEAR I
59 C
60 IF (SIM(K) .EQ. 1) GO TO 35
61 DO 30 I=1,6
62 IF (I.EQ.1) SNGRAD(I,K)=ROUND(GRAOS(I,I))
63 IF (I.GT.1) SNGRAD(I,K)=ROUND(GRAOS(I,I) + GRADS(I-1,I))
64 CONTINUE
65 C
66 C NO. OF YEAR I ENTRANTS WASHING OUT IN YEAR J(J=I,I+1)
67 C
68 CONTINUE
69 DO 40 I=1,5
70 I1=I+1
71 DO 40 J=I, I1
72 IF (J.EQ.I) WASH(I,J)=ROUND(IFRATE(I) * (A12/DEI+1.-DMCD/DEI))
73 IF (J.EQ.I+1) WASH(I,J)=FAIL(I) - WASH(I,I)
74 CONTINUE
75 C
76 C TOTAL NO. WASHOUTS IN YEAR I
77 C
78 DO 45 I=1,6
79 IF (I.EQ.1) SNWASH(I,K)=ROUND(WASH(I,I))
80 IF (I.GT.1) SNWASH(I,K)=ROUND(WASH(I-1,I)+WASH(I,I))
81 CONTINUE
82 C
83 C
84 DO 50 I=1,6
85 C MAN-YEARS FOR YEAR I ENTRANTS GRADUATING IN YEAR I
86 IF (I.LE.5) EIGI=GRAOS(I,I) * DGCD/A12
87 IF (I.EQ.6) EIGI=0.
88 C MAN-YEARS FOR YEAR I ENTRANTS GRADUATING IN YEAR I+1
89 IF (I.LE.5) EIGI1=GRAOS(I,I+1) * DGCD/A24
90 IF (I.EQ.6) EIGI1=0.
91 C MAN-YEARS FOR YEAR I-1 ENTRANTS GRADUATING IN YEAR I
92 IF (I.EQ.1) EIMIGI=0.
93 IF (I.GT.1) EIMIGI=GRAOS(I-1,I) * DGCD/A24
94 C MAN-YEARS FOR YEAR I ENTRANTS WASHING OUT IN YEAR I
95 EIMI=WASH(I,I) * DMCD/A12
96 C MAN-YEARS FOR YEAR I ENTRANTS WASHING OUT IN YEAR I+1
97 EIMI1=WASH(I,I+1) * DMCD/A24
98 C MAN-YEARS FOR YEAR I-1 ENTRANTS WASHING OUT IN YEAR I
99 EIMI1=WASH(I-1,I) * DMCD/A24
100 C TOTAL MAN-YEARS IN YEAR I (GRADUATES + WASHOUTS)

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101      IF(SIM(K).EQ.0)SMYRS(I,K)=EIGI+EIGIP1+EIMIGI+EIMI+EIMPI+EIMI
102 50      CONTINUE
103 C
104 1000      CONTINUE
105      RETURN
106 C*****RHPK
107 C
108 C
109 C      12 < COURSE DURATION <= 24 MONTHS
110 C
111 2000      CONTINUE
112 C
113      NS = NTYPE(S)
114      DO 3000 K=1,NS
115      =====
116 C
117      CALL INITF(GRATE,7)
118      CALL INITF(FRATE,7)
119      CALL INITF(GRADS,49)
120      CALL INITF(WASH,49)
121 C
122 C GRAD. RATE, FAIL. RATE, FOR STUDENTS ENTERING IN YEAR I (PER MO.)
123 C
124      DO 2010 I=1,5
125      COMPL(I) = ROUND0(SENTS(I,K)/(1.-DMR/100.))
126      FAIL(I) = SENTS(I,K)-COMPL(I)
127      GRATE(I)=COMPL(I)/(A12/DEI)
128      FRATE(I)=SENTS(I,K)/(A12/DEI) - GRATE(I)
129 2010      CONTINUE
130 C

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1 C NO. OF YEAR I ENTRANTS GRADUATING IN YEAR J(J=I+1,I+2)
2 C
3 DO 2020 I=1,5
4 I1=I+1
5 I2=I+2
6 DO 2020 J=I1,I2
7 IF(J=I+1)GRADS(I,J)=ROUND(GRATE(I)*AINT(A24/DEI+1.-DGED/DEI))
8 IF(J=I+2)GRADS(I,J)=COMPLY(I) - GRADS(I,J-1)
9 2020 CONTINUE
10 C
11 C TOTAL NO. GRADUATES IN YEAR I
12 C
13 IF(SIM(K).EQ. 1)GO TO 2035
14 DO 2030 I=1,7
15 IF(I.EQ.1) SNGRAD(I,K)=0.
16 IF(I.EQ.2) SNGRAD(I,K)=ROUND(GRADS(I-1,I))
17 IF(I.EQ.3) SNGRAD(I,K)=ROUND(GRADS(I-1,I)+GRADS(I-2,I))
18 IF(I.EQ.4) SNGRAD(I,K)=ROUND(GRADS(I-1,I)+GRADS(I-2,I)+GRADS(I-3,I))
19 IF(I.EQ.5) SNGRAD(I,K)=ROUND(GRADS(I-1,I)+GRADS(I-2,I)+GRADS(I-3,I)+GRADS(I-4,I))
20 2030 CONTINUE
21 C
22 C NO. OF YEAR I ENTRANTS WASHING OUT IN YEAR J(J=I+1,I+2)
23 C
24 2035 CONTINUE
25 DO 2040 I=1,5
26 I1=I+1
27 DO 2040 J=I1,I1
28 IF(J=I+1) WASH(I,J)=ROUND(FRATE(I)*AINT(A12/DEI+1.-DMCD/DEI))
29 IF(J=I+2) WASH(I,J)=FAIL(I) - WASH(I,J-1)
30 2040 CONTINUE
31 C
32 C
33 C TOTAL NO. WASHOUTS IN YEAR I
34 C
35 DO 2043 I=1,6
36 IF(I.EQ.1)SNWASH(I,K)=ROUND(WASH(I,I))
37 IF(I.EQ.2)SNWASH(I,K)=ROUND(WASH(I-1,I)+WASH(I,I))
38 2043 CONTINUE
39 C
40 C
41 DO 2050 I=1,7
42 C MAN-YEARS FOR YEAR I ENTRANTS WHO WILL SUCCESSFULLY COMPLETE COURSE
43 IF(I.EQ.1)EI=0.542*(SENTS(I,K)-WASH(I,I)-WASH(I,I+1))
44 IF(I.EQ.2)EI=0.
45 C MAN-YEARS FOR YEAR I-1 ENTRANTS GRADUATING IN YEAR I
46 IF(I.EQ.1)EI=EI+EI*EI
47 IF(I.EQ.2)EI=EI+EI*EI
48 C MAN-YEARS FOR YEAR I-1 ENTRANTS GRADUATING IN YEAR I+1
49 IF(I.EQ.1)EI=EI+EI*EI
50 IF(I.EQ.2)EI=EI+EI*EI

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51 C MAN-YEARS FOR YEAR I-2 ENTRANTS GRADUATING IN YEAR I
52 IF(I.EQ.1.OR.1.EQ.2) EIM2GI=0.
53 IF(I.GT.2) EIM2GI=GRADS(I-2,I) * (OGCO-A12)/A24
54 C MAN-YEARS FOR YEAR I ENTRANTS WASHING OUT IN YEAR I
55 EIMI=WASH(I,I) * DMCO/A12
56 C MAN-YEARS FOR YEAR I ENTRANTS WASHING OUT IN YEAR I+1
57 IF(I.LE.5)EIMPI=WASH(I,I+1) * DMCO/A24
58 IF(I.GT.5)EIMPI=0.
59 C MAN-YEARS FOR YEAR I-1 ENTRANTS WASHING OUT IN YEAR I
60 EIMI=WASH(I-1,I) * DMCO/A24
61 C TOTAL MAN-YEARS IN YEAR I (GRADUATES + WASHOUTS)
62 C LUMP YEARS 6 AND 7 TOGETHER
63 IF(SIMK).EQ.1 GO TO 2045
64 SUM=EIMI*EIMGI+EIM2GI + EIMI+EIMPI+EIMI
65 IF(I.LT.7) SMYRS(I,K)=SUM
66 IF(I.EQ.7) SMYRS(I-1,K)=SMYRS(I-1,K) + SUM
67 2045 CONTINUE
68 2050 CONTINUE
69 C
70 3000 CONTINUE
71 RETURN
72 END

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MODULE: NOL 30 OUT1
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51 DO 10100 J=1,5
52 VI(IROW,J) = VI(IROW,J) + SNGRAD(J,I)
53 10100 CONTINUE
54 C (COL. 7 = "IN PROGRESS" = YEAR 6)
55 VI(IROW,7) = VI(IROW,7) + SNGRAD(6,I)
56 10200 CONTINUE
57 C
58 C ROUND TO INTEGER VALUES
59 DO 10250 I=1,10
60 DO 10250 J=1,7
61 VI(I,J) = ROUND(VI(I,J))
62 10250 CONTINUE
63 C
64 C CALCULATE TOTAL GRADUATES FOR YEARS 1-5
65 DO 10300 J=1,5
66 DO 10300 I=1,10
67 VI(11,J) = VI(11,J) + VI(I,J)
68 10300 CONTINUE
69 C
70 C CALCULATE TOTAL ENTRANTS, TOTAL WASHOUTS, FOR YEARS 1-5
71 DO 10310 I=1,N
72 DO 10310 J=1,5
73 VI(12,J) = VI(12,J) + SENTS(J,I)
74 VI(13,J) = VI(13,J) + SNWASH(J,I)
75 10310 CONTINUE
76 C
77 C CALCULATE SUBTOTALS
78 DO 10400 I=1,13
79 DO 10400 J=1,5
80 VI(I,6) = VI(I,6) + VI(I,J)
81 10400 CONTINUE
82 C
83 C
84 C CALCULATE TOTAL GRADS, "IN PROGRESS" (=COL 7)
85 DO 10410 I=1,10
86 VI(11,7) = VI(11,7) + VI(I,7)
87 10410 CONTINUE
88 C
89 C CALCULATE TOTAL ENTRANTS, TOTAL WASHOUTS, "IN PROGRESS" (COL 7)
90 DO 10420 I=1,N
91 VI(12,7) = VI(12,7) + SENTS(6,I)
92 VI(13,7) = VI(13,7) + SNWASH(6,I)
93 10420 CONTINUE
94 C
95 C CALCULATE "TOTAL" COLUMN (COL 9)
96 DO 10430 I=1,13
97 VI(I,8) = VI(I,6) + VI(I,7)
98 10430 CONTINUE
99 C
100 10650 CONTINUE

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101 C *** PRINT ***
102 C
103 C
104 10700 CALL HEAD
105 C
106 WRITE(6,11000)
107 11000 FORMAT(1M0, 46X, 16MGRADUATE SUMMARY /47X, 8(2M==) /1X/1X)
108 C
109 WRITE(6,11100) OGCD, DMR, DMCD, DEI
110 11100 FORMAT(30X, 39HAVERAGE COURSE DURATION FOR GRADUATES =,
111 F6.1, 7M HOURS / 1X /
112 30X, 14WASHOUT RATE =, F6.1, 1M / 1X /
113 30X, 39HAVERAGE COURSE DURATION FOR WASHOUTS =,
114 F6.1, 7M HOURS / 1X /
115 30X, 24MSTUDENT ENTRY INTERVAL =,
116 F6.1, 7M HOURS / 1X / 1X)
117 C
118 WRITE(6,11200)
119 11200 FORMAT(15X, 13MGRADUATE TYPE, 47X,
120 27HNUMBER OF GRADUATES BY YEAR /
121 15X, 6(2M--),1M-, 47X, 13(2M--),1M- /
122 57X, 1M1, 6X, 1M2, 6X, 1M3, 6X, 1M4, 5X, 1M5,
123 5X, 8MSJBTOTAL, 3X, 11MIN PROGRESS, 3X, 5HTOTAL)
124 C
125 WRITE(6,11300) ((VI(I,J),J=1,8),I=1,11), (V1(12,J),J=1,6), V1(12,8),
126 (V1(13,J),J=1,8)
127 11300 FORMAT(15X, 13HACTIVE DUTY FORCES,
128 22X, 5(5M====,2X),1X,4(2M==),3X,5(2M==),1M-,3X,5H=====
129 17X, 8MOFFICERS, 29X, 5F7.0, F9.0, F13.0, F11.0 /
130 17X, 6HAIRMEN, 30X, 5F7.0, F9.0, F13.0, F11.0 /

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1 17X, 9MCIVILIANS,27X, 5F7.0, F9.0, F13.0, F11.0 /
2 15X, 2ANGUARD AND RESERVE FORCES /
3 17X, 9HOFFICERS, 28X, 5F7.0, F9.0, F13.0, F11.0 /
4 17X, 6HAIRMEN, 30X, 5F7.0, F9.0, F13.0, F11.0 /
5 17X, 9MCIVILIANS,27X, 5F7.0, F9.0, F13.0, F11.0 /
6 15X, 21MOTHER DOD (ARMY,NAVY) /
7 17X, 9HOFFICERS, 28X, 5F7.0, F9.0, F13.0, F11.0 /
8 17X, 6HAIRMEN, 30X, 5F7.0, F9.0, F13.0, F11.0 /
9 17X, 9MCIVILIANS,27X, 5F7.0, F9.0, F13.0, F11.0 /
10 15X, 13NON-DOD (MAP), 25X, 5F7.0, F9.0, F13.0, F11.0 /
11 54X, 57M-----1, 2X, 3(2M--), 7X, 3(2M--), 5X, 3(2M--)/
12 15X, 15HTOTAL GRADUATES, 23X,5F7.0, F9.0, F13.0, F11.0 / 1X /
13 15X,14HTOTAL ENTRANTS, 24X,5F7.0, F9.0, F13.0, F11.0 / 1X /
14 15X, 14HTOTAL WASHOUTS, 24X,5F7.0, F9.0, F13.0, F11.0 /
15 RETURN
16 END

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101 DO 10300 J=1,6
102 DO 10300 I=1,10
103 V2(I,I,J) = V2(I,I,J) + V2(I,I,J)
104 10300 CONTINUE
105 C
106 C *** BASE PERMANENT PARTY ***
107 C
108 C ** INSTRUCTORS **
109 C
110 11000 NT=NTYPE(I)
111 IF(NT.EQ. 0) GO TO 11250
112 DO 11200 I=1,NT
113 ITT = IT(I)
114 IPO = IPO(I)
115 C
116 C *AIR FORCE*
117 IF(ITT.EQ. 8) IPOW=12
118 C
119 C *OTHER DOD*
120 IF(ITT.EQ. 9) IPOW=13
121 C
122 C ADD INSTRUCTOR MAN-YEARS INTO MATRIX
123 DO 11100 J=1,6
124 V2(IPOW,J) = V2(IPOW,J) + ITN(J,I)
125 11100 CONTINUE

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1 11200 CONTINUE
2 C
3 C ** CURRICULUM PERSONNEL **
4 C
5 11250 NC=NTYPE(C)
6 IF(NC.EQ.0)GO TO 12200
7 DO 11600 I=1,NC
8 I4 = RIM(I)
9 C
10 C IF IM=0, THERE WAS NO CURRICULUM MANPOWER INPUT CORRESPONDING
11 C TO THE I-TH COURSEWARE PROCUREMENT ID
12 C
13 IF(IM.EQ.0)GO TO 11600
14 IF(IM.EQ.2)GO TO 11400
15 C
16 C METHOD 1 -- CALCULATION
17 C YEAR 0
18 C
19 TERM = (RNCH(I)*RNPCH(I)*(1.-RIPA(I)/100.)) / (QAOHPM*12.)
20 V2(14,I) = V2(14,I) + TERM
21 YEARS 1-5
22 C
23 DO 11300 J=2,6
24 V2(14,J) = V2(14,J) + TERM* 0.5*(CARV(I)/100.
25 11300 CONTINUE
26 GO TO 11600
27 C
28 C METHOD 2 -- THRUPUT
29 11400 DO 11500 J=1,6
30 V2(14,J) = V2(14,J) + RNP(J,I)
31 11500 CONTINUE
32 11600 CONTINUE
33 C
34 C ** HARDWARE MTC PERSONNEL **
35 C
36 12200 NH=NTYPE(H)
37 IF(NH.EQ.0)GO TO 13200
38 DO 12600 I=1,NH
39 I4 = EIM(I)
40 C
41 C IF IM=0, THERE WAS NO HARDWARE MANPOWER INPUT CORRESPONDING
42 C TO THE I-TH HARDWARE PROCUREMENT ID
43 C
44 IF(IM.EQ.0)GO TO 12600
45 IF(IM.EQ.2)GO TO 12400
46 C
47 C METHOD 1 -- CALCULATION
48 DO 12300 J=1,5
49 J1= J+1
50 V2(15,J1) = V2(15,J1) + (EDUR(J,I)*QATDPM*EFRPM(I)*EAVRT(I)*

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1 12300 CONTINUE ~
2 63 TO 12600
3 C
4 C METHOD 2 -- THRUPUT
5 12400 DO 12500 J=1,5
6  J1= J+1
7  V2(15,J1) = V2(15,J1) + ENP(J,I)
8 12500 CONTINUE
9 12600 CONTINUE
10 C
11 C ** FACILITIES MTC PERSONNEL **
12 C
13 13200 NF=NTYPE(F)
14 IF(NF.EQ. 0) GO TO 13605
15 DO 13600 I=1,NF
16  IM = GIM(I)
17 C
18 C IF IM=0, THERE WAS NO FACILITIES MANPOWER INPUT CORRESPONDING
19 C TO THE I-TH FACILITIES PROCUREMENT ID
20 C
21 IF(IM.EQ. 0) GO TO 13600
22 IF(IM.EQ. 2) GO TO 13400
23 C
24 C METHOD 1 -- CALCULATION
25 DO 13300 J=1,5
26  J1= J+1
27  V2(16,J1) = V2(16,J1) + (GMPSE(I)*GSPDE(I)*FNURQ(J,I)) / QAOMPM
28 13300 CONTINUE
29  GO TO 13600
30 C
31 C METHOD 2 -- THRUPUT
32 13400 DO 13500 J=1,5
33  J1= J+1
34  V2(16,J1) = V2(16,J1) + GNP(J,I)
35 13500 CONTINUE
36 13600 CONTINUE
37 C
38 C *****
39 C TYPE A * TYPE B CALCULATIONS
40 C *****
41 13605 CALL INITF(FCSB,6)
42  CALL INITF(TOYB,6)
43  CALL INITF(FCSM,6)
44  CALL INITF(TOYM,6)
45  IF(NS.EQ. 0) GO TO 13750
46  IF(IFLAG.EQ. 1) GO TO 13660
47 C
48 C TYPE B (TOY). IFLAG=0
49 C
50 C

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101 DO 13650 I=1,NS
102 IPO = SPD(I)
103 IST = ST(I)
104 GO TO(13630,13610,13630,13510,13630,13610,13610), IST
105 C
106 C TDY = STUDENT TYPES 2,4,6,7
107 13610 DO 13620 J=1,5
108 JI= J+1
109 TDYB(JI) = TDYB(JI) + SMYRS(J,I)
110 IF(IPO .GT. 2 .AND. IPO .NE. 5) GO TO 13620
111 TDYM(JI) = TDYM(JI) + SMYRS(J,I)
112 13620 CONTINUE
113 GO TO 13650
114 C
115 C PCS = STUDENT TYPES 1,3,5
116 13630 DO 13640 J=1,5
117 JI= J+1
118 PCSB(JI) = PCSB(JI) + SMYRS(J,I)
119 IF(IPO .GT. 2) GO TO 13640
120 PCSM(JI) = PCSM(JI) + SMYRS(J,I)
121 13640 CONTINUE
122 13650 CONTINUE
123 GO TO 13690
124 C
125 C TYPE A (PCS). IFLAG=1
126 C
127 C PCS-BASE OP. = SUM OF ALL STUDENTS. TDY=0
128 C
129 13660 DO 13670 J=1,5
130 PCSB(J) = V2(11,J)
131 13670 CONTINUE
132 C
133 C PCS-MEDICAL = PERSONNEL DESIGNATOR 1,2,5
134 C
135 DO 13685 I=1,NS
136 IF(SPD(I) .GT. 2 .AND. SPD(I) .NE. 5) GO TO 13685
137 DO 13690 J=1,5
138 JI= J+1
139 PCSM(JI) = PCSM(JI) + SMYRS(J,I)
140 13680 CONTINUE
141 13695 CONTINUE
142 C
143 C
144 13690 CONTINUE
145 C
146 C TYPE A MAN-YEARS (PCS)
147 C
148 C CALCULATE SUM OF MILITARY INSTRUCTOR MAN-YEARS
149 C
150 13750 IF(NT .EQ. 0) GO TO 13835

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151 CALL INITF( TMIL,6)
152 DO 13425 I=1,NT
153 IF(1P0(I).GT. 2) GO TO 13425
154 DO 13400 J=1,6
155 TMIL(J) = TMIL(J) + TN(J,I)
156 13400 CONTINUE
157 13425 CONTINUE
158 C
159 C CALCULATE SUM OF OTHER MILITARY PERSONNEL MAN-YEARS
160 C
161 13435 CALL INITF(CMIL,6)
162 DO 13450 J=1,6
163 OMIL(J) = OMIL(J) + (V2(14,J)*(QCOFF+QCAMN) + V2(15,J)*(QHOFF+QHAMN)
164 1 + V2(16,J)*(QOIFF+QFAMN) + V2(17,J)*(QAOFF+QAAMN)
165 2 + V2(18,J)*(Q3OFF+Q3AMN))/100.
166 13450 CONTINUE
167 C

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1 C (END OF TYPE A, TYPE B CALCULATIONS)
2 C *****RHPK
3 C
4 MA=NTYPE(A)
5 IF (NA.EQ. 0) GO TO 14925
6 DO 14900 I=1,NA
7 IM = AIM(I)
8 IPT = APT(I)-12
9 GO TO(14100,14400,14700), IPT
10 C
11 C ** TRAINING ADMINISTRATIVE **
12 C
13 14100 IF (IM.EQ. 2) GO TO 14300
14 C
15 C METHOD 1 -- CALCULATION
16 DO 14200 J=2,6
17 V2(17,J) = AFMPC(I)+AVMPCS(I)*(V2(11,J)+V2(12,J)+V2(13,J)+V2(14,J))
18 14200 CONTINUE
19 GO TO 14900
20 C
21 C METHOD 2 -- THRUPUT
22 14300 DO 14325 J=1,6
23 V2(17,J) = ANP(J,I)
24 14325 CONTINUE
25 GO TO 14900
26 C
27 C ** BASE OPERATING SUPPORT PERSONNEL **
28 C
29 14400 IF (IM.EQ. 2) GO TO 14600
30 C
31 C METHOD 1 -- CALCULATION
32 DO 14500 J=1,6
33 V2(18,J) = AFMPC(I) + AVMPCS(I)*(PCSB(J)+V2(12,J)+V2(13,J)+
34 V2(14,J)+V2(15,J)+V2(16,J)+V2(17,J))
35 + AVMTDY(I)*TDYB(J)
36 14500 CONTINUE
37 GO TO 14900
38 C
39 C METHOD 2 -- THRUPUT
40 14600 DO 14625 J=1,6
41 V2(18,J) = ANP(J,I)
42 14625 CONTINUE
43 GO TO 14900
44 C
45 C ** MEDICAL PERSONNEL **
46 C
47 14700 IF (IM.EQ. 2) GO TO 14900
48 C
49 C METHOD 1 -- CALCULATION
50 DO 14750 J=1,6

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51 V2(19,J) = AFMPC(I) + AVHPCS(I) + (PCSM(J) + TNMIL(J) + OMIL(J))
52 1
53 14750 CONTINUE
54 GO TO 14900
55 C
56 C METHOD 2 -- THRUPUT
57 14800 DO 14825 J=1,6
58 V2(19,J) = ANP(J,I)
59 14825 CONTINUE
60 GO TO 14900
61 14900 CONTINUE
62 C
63 C ROUND TO 1 DECIMAL PLACE
64 14925 DO 14950 I=12,19
65 DO 14950 J=1,6
66 V2(I,J) = ROUND1(V2(I,J))
67 14950 CONTINUE
68 C
69 15000 CONTINUE
70 C TOTAL BASE PERMANENT PARTY
71 DO 15100 J=1,6
72 DO 15100 I=12,19
73 V2(20,J) = V2(20,J) + V2(I,J)
74 15100 CONTINUE
75 C
76 C TOTAL COURSE MAN-YEARS
77 DO 15200 J=1,6
78 V2(21,J) = V2(20,J) + V2(11,J)
79 15200 CONTINUE
80 C
81 C ACTIVE DUTY FORCE PCS STUDENT LOAD
82 C ACTIVE DUTY FORCE TDY STUDENT LOAD
83 IF(NS.EQ.0) GO TO 15675
84 IF(IFLAG.EQ.1) GO TO 15400
85 C IFLAG=0 (TDY=LATERAL AND UPGRADE)
86 DO 15300 I=1,NS
87 IST = ST(I)
88 IF(IST.GT.2) GO TO 15300
89 IF(IST.EQ.1) IROM=22
90 IF(IST.EQ.2) IROM=25
91 DO 15250 J=1,5
92 J1 = J+1
93 V2(IROM,J1) = V2(IROM,J1) + SMYRS(J,I)
94 15250 CONTINUE
95 15300 CONTINUE
96 GO TO 15600
97 C IFLAG=1 (PCS = PIPELINE + LATERAL AND UPGRADE)
98 15400 DO 15500 I=1,NS
99 IST = ST(I)
100 IF(IST.GT.2) GO TO 15500

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101 DO 15450 J=1,5
102 J1 = J+1
103 V2(22,J1) = V2(22,J1) + SMYRS(J,I)
104 15450 CONTINUE
105 15500 CONTINUE
106 15600 CONTINUE
107 C ROUND
108 C ROUND
109 C
110 DO 15650 J=1,6
111 V2(22,J) = ROUND1(V2(22,J))
112 V2(25,J) = ROUND1(V2(25,J))
113 15650 CONTINUE
114 C
115 C BASE PERMANENT PARTY -- AF ONLY
116 15675 DO 15700 J=1,6
117 V2(23,J) = V2(20,J) - V2(13,J)
118 15700 CONTINUE
119 C
120 C TOTAL PROGRAM 8 MAN-YEARS
121 DO 15900 J=1,6
122 V2(24,J) = V2(22,J) + V2(23,J)
123 15900 CONTINUE
124 C
125 C GUARD AND RESERVE STUDENT LOAD
126 DO 15900 J=1,6
127 V2(26,J) = V2(4,J) + V2(5,J) + V2(6,J)
128 15900 CONTINUE
129 C
130 C TOTAL AF MAN-YEARS
131 DO 15950 J=1,6
132 V2(27,J) = V2(24,J) + V2(25,J) + V2(26,J)
133 15950 CONTINUE
134 C
135 C ROW TOTALS
136 C
137 DO 15975 I=1,27
138 DO 15975 J=1,6
139 V2(I,7) = V2(I,7) + V2(I,J)
140 15975 CONTINUE
141 C
142 C *** PRINT ***
143 C
144 CALL HEAD
145 C
146 WRITE(6,16100)
147 16100 FORMAT(1H0, 41X, 20HMANPOWER SUMMARY (MAN-YEARS) /
148 X 42X, 14(2H=) /
149 X 75X, 4HYEAR / 1X /
150 X 50X, 1H0, 9X, 1H1, 9X, 1H2, 9X, 1H3, 9X, 1H4,

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151	X	9X, 1M5, 9X, 5MTOTAL /
152	X	5X, 8NSTUDENTS, 34X, 6(7M=====, 3X), 2X, 7M===== /
153	X	7X, 17NACTIVE DUTY FORCE)
154	C	WRITE(6,16200) ((V2(I,J),J=1,7), I=1,11)
155		FORMAT(9X, 7NOFFICER, 28X,
156	16200	9X, 6MAIRMEN, 29X,
157	X	9X, 8NCIVILIAN, 27X,
158	X	7X, 17NGUARD AND RESERVE /
159	X	9X, 7NOFFICER, 28X,
160		6F10.1, F12.1 /
		6F10.1, F12.1 /
		6F10.1, F12.1 /
		6F10.1, F12.1 /

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1  X  9X, 6CHAIRMAN, 29X, 5F10.1, F12.1 /
2  X  9X, 6CIVILIAN, 27X, 6F10.1, F12.1 /
3  X  7X, 21MOTHER DOD (ARMY,NAVY) /
4  X  9X, 7HOFFICER, 28X, 6F10.1, F12.1 /
5  X  9X, 6CHAIRMAN, 29X, 6F10.1, F12.1 /
6  X  9X, 6CIVILIAN, 27X, 6F10.1, F12.1 /
7  X  7X, 13MNON-DOD (MAP), 24X, 5F10.1, F12.1 /
8  X  47X, 5(7H)-----, 3X), 2X, 7H----- /
9  X  5X, 20H* TOTAL STUDENT LOAD, 19X, 6F10.1, F12.1 )
10 C
11 WRITE(6,16300) ((V2(I,J),J=1,7),I=12,21 )
12 16300 FORMAT(1H0, 4X, 20HBASE PERMANENT PARTY /
13 7X, 11HINSTRUCTORS /
14 9X, 9HAIR FORCE, 26X, 6F10.1, F12.1 /
15 9X, 21MOTHER DOD (ARMY,NAVY), 14X, 6F10.1, F12.1 /
16 7X, 20HCURRICULUM PERSONNEL, 17X, 6F10.1, F12.1 /
17 7X, 30HWAREHOUSE MAINTENANCE PERSONNEL, 7X, 6F10.1, F12.1 /
18 7X, 32HFACILITIES MAINTENANCE PERSONNEL, 5X, 6F10.1, F12.1 /
19 7X, 33HTRAINING ADMINISTRATIVE PERSONNEL, 4X, 6F10.1, F12.1 /
20 7X, 32HBASE OPERATING SUPPORT PERSONNEL, 5X, 6F10.1, F12.1 /
21 7X, 17HMEDICAL PERSONNEL, 20X, 6F10.1, F12.1 /
22 47X, 5(7H)-----, 3X), 2X, 7H----- /
23 5X, 28H* TOTAL BASE PERMANENT PARTY, 11X, 6F10.1, F12.1 /
24 47X, 5(7H)-----, 3X), 2X, 7H----- /
25 5X, 24H* TOTAL COURSE MAN-YEARS, 15X, 6F10.1, F12.1/1X(1K)
26 C
27 WRITE(6,16400) ((V2(I,J),J=1,7),I=22,27 )
28 16400 FORMAT(1H0, 4X, 34HACTIVE DUTY FORCE PCS STUDENT LOAD, 5X,
29 6F10.1, F12.1/
30 5X, 10HBASE PERMANENT PARTY - AF ONLY, 9X, 6F10.1, F12.1/
31 47X, 5(7H)-----, 3X), 2X, 7H----- /
32 5X, 27H* TOTAL PROGRAM 6 MAN-YEARS, 12X, 6F10.1, F12.1 /
33 5X, 34HACTIVE DUTY FORCE TOY STUDENT LOAD, 5X, 6F10.1, F12.1/
34 5X, 30HGUARD AND RESERVE STUDENT LOAD, 9X, 6F10.1, F12.1/
35 47X, 5(7H)-----, 3X), 2X, 7H----- /
36 5X, 27H* TOTAL AIR FORCE MAN-YEARS, 12X, 6F10.1, F12.1 )
37 RETURN
38 END

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1 SUBROUTINE OUT3
2
3 C
4 C
5 C
6 C
7 C
8 C
9 C
10 INTEGER U,D,S,T,C,R,M,E,F,G,A,B,O,OO,P,M
11 INTEGER TT,TPD,TPG
12 INTEGER CID,CC
13 INTEGER RDX,RIMX,RID,RIM
14 INTEGER MID,HC,HOD
15 INTEGER EIDX,EIMX,EID,EIM
16 INTEGER FID
17 INTEGER GIDY,GIMX,GID,GIM
18 INTEGER BID
19 COMMON/ALL/ NTYPE(20),NTYPE(20),LPP,NLINES,IPAGE,TITLE(39),IFLAG,
20 U,D,S,T,C,R,M,E,F,G,A,B,O,OO,P,M
21 COMMON/S/ ST(75),SPD(75),SPG(75),SIM(75),SNGRAD(7,75),
22 SMYRS(7,75),SENTS(7,75),SNMASH(7,75)
23 COMMON/T/ TT(25),TPD(25),TPG(25),TSIIC(25),TN(6,25),TTR(25),
24 TNM08,TIFTC,TEFC
25 COMMON/C/ CIO(75),CO(75),CTYPE(11,75),CCOPY(2,75),CMEAS(3,75),
26 CNURQ(5,75),CNMU(75),CIPCH(75),CCCM(75),CPC(75),
27 CARV(75),CARP(75)
28 COMMON/R/ RDX(75),RIMX(75),RID(75),RIM(75),RNCHX(75),
29 RMPCHX(75),RIPAX(75),RNPX(5,75),RNCH(75),
30 RMPCH(75),RIPA(75),RNP(6,75)
31 COMMON/H/ HIO(75),HC(75),HOD(75),HMAF(75),HPCUY(75),HISR(75),
32 HNUAV(75),HPCU(75),HMAF(75),HPCUY(75),HISR(75),
33 EIDX(75),EIMX(75),EID(75),EIM(75),EDURX(5,75),
34 EFRPHX(75),EAVRTX(75),ENPX(5,75),EDUR(5,75),
35 EFRPH(75),EAVRT(75),ENP(5,75)
36 COMMON/F/ FID(25),FTYPE(15,25),FCCPU(25),FNURQ(5,25),
37 FNUAV(25)
38 COMMON/G/ GIDY(25),GIMX(25),GID(25),GIM(25),GSEPF(25),
39 GMPSEF(25),GNPX(5,25),GSEPF(25),GMPSEF(25),GNP(5,25)
40 COMMON/B/ BSC(5),BIO(3),BTYPE(3,15),BCAP(3),BCOST(3),BNURQ(5,3)
41 COMMON/V1/ V1(13,4)
42 DIMENSION YESNO(4),CREDIT(2),TCHRS(5),TURNVR(5),UNITS(5),
43 X UNITS2(5)
44 C
45 DATA YESNO(1)/2H N/, YESNO(2)/2H0 /, YESNO(3)/2HVE/,
46 YESNO(4)/2HS /
47 C
48 C
49 CALL HEAD
50 C

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51 WRITE(6,3100)
52 3100 FORMAT(1H0, 26X, 16HCOURSEWARE, HARDWARE, AND FACILITIES,
53 X 21H REQUIREMENTS BY YEAR /
54 X 27X, 28(2H==),1H= / 1X / 1X )
55 C
56 C
57 C
58 C
59 C
60 C
61 WRITE(6,3200)
62 3200 FORMAT( 7X, 13H*** COURSEWARE *** , 36X, 7HINITIAL /
63 X 36X, 4HNAME, 3X, 4HNAME, 15X, 5HREP., 5X, 4HCOPY,
64 X 5X, 6HMANUAL, 12X, 23HCOPIES REQUIRED BY YEAR /
65 X 37X, 2HOF, 5X, 2HOF, 5X, 8HMEASURES, 2X, 8HCOST($)/,
66 X 2X, 8HCOST($)/, 2X, 8HREVISION,
67 X 11X, 11(2H==),1H= /
68 X 36X, 4HCOPY, 2X, 7HMEASURE, 3X, 5H/COPY, 4X, 7HMEASURE,
69 X 3X, 7HMEASURE, 3X, 7HDATE( ),
70 X 36X, 1H1, 5X, 1H2, 6X, 1H3, 6X, 1H4, 6X, 1H5 /
71 X 36X, 4H=====, 2X, 7H=====, 4(2X, 8H=====), 4X,
72 X 5(2X, 5H=====) )
73 C
74 NC = NTYPE(C)
75 IF( NC.EQ. 0 ) GO TO 5300
76 C*****
77 C ** CALCULATE DEFAULT VALUE FOR NO. REQUIRED UNITS OF PRINTED MEDIA **
78 C
79 NT = NTYPE(I)
80 IF( NT.GT. 0 ) GO TO 3400
81 C NO. UNITS REQUIRED IN YEAR J = NO. ENTRANTS IN YEAR J IF NO. INSTR. = 0
82 DO 3300 J=1,5
83 UNITS1(J) = V1(12,J)
84 UNITS2(J) = 0.
85 3300 CONTINUE
86 GO TO 3700
87 C
88 C CALCULATE NO. INSTRUCTOR MAN-YEARS AND INSTR. TURNOVER IN YEARS 1-5
89 3400 CALL INITF( TCHRS,5)
90 CALL INITF( TURNVR,5)
91 DO 3500 I=1,NT
92 DO 3500 J=1,5
93 J1 = J+1
94 TCHRS(J1) = TCHRS(J) + TN(J1,I)
95 TURNVR(J1) = TURNVR(J) + TN(J1,I)*TTR(I)/100.
96 3500 CONTINUE
97 DO 3550 J=1,5
98 TURNVR(J) = ROUND0(TURNVR(J))
99 3550 CONTINUE
100

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101 C      NO. UNITS REQUIRED
102 C
103 C
104      UNITS1(1) = V1(12,1) + TCHRS(1) + TURNVR(1)
105      UNITS2(1) = UNITS1(1) - V1(12,1)
106      DO 3600 J=2,5
107      UNITS1(J) = V1(12,J) + AMAX1( (TCHRS(J)-TCHRS(J-1)),0.) + TURNVR(J)
108      UNITS2(J) = UNITS1(J) - V1(12,J)
109 3600 CONTINUE
110 3700 CONTINUE
111 C.....*****RHPK
112 C

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TIME: 10.28.19          SHARED          MDL 17 SPOOLLER10
1  C PRINTED MEDIA, CLASS=1 OR 2
2  C
3  IC = 1
4  WRITE(6,3000)
5  3000 FORMAT(1X,13HPRINTED MEDIA )
6  GO TO 5000
7  C DISPLAY MEDIA, CLASS=1
8  C
9  IC = 2
10 4100 WRITE(6,4200)
11 4200 FORMAT(1X,13HDISPLAY MEDIA )
12 GO TO 5000
13 C SOFTWARE, CLASS=4
14 C
15 C
16 C
17 4300 IC = 3
18 4400 WRITE(6,4400)
19 4400 FORMAT(1X,13HSOFTWARE )
20 GO TO 5000
21 4500 GO TO 5000
22 C
23 C COURSEWARE #SUBROUTINE#
24 C
25 5000 NCC = 0
26 C
27 C SCAN FOR COURSEWARE CLASS #IC#
28 DO 5500 I=1,NCC
29 IF(IC.EQ.1.AND.CC(I).LE.2)GO TO 5050
30 IF(IC.EQ.2.AND.CC(I).EQ.3)GO TO 5050
31 IF(IC.EQ.3.AND.CC(I).EQ.4)GO TO 5050
32 C
33 C ELSE...
34 GO TO 5500
35 C
36 5050 NCC = NCC+1
37 IF(IC.NE.1)GO TO 5300
38 C
39 C CLASS=1 OP 2 (PRINTED). CALC CNURQ IF INPUT VALS. FOR YRS. 1-5 ALL = 0
40 DO 5100 J=1,5
41 IF(CNURQ(J,I).NE.0)GO TO 5300
42 5100 CONTINUE
43 C
44 C REPLACE INPUT VALUE WITH CALCULATED NO., UNITS REQUIRED
45 DO 5200 J=1,5
46 IF(CC(I).EQ.1)CNURQ(J,I)=UNITS1(J)
47 IF(CC(I).EQ.2)CNURQ(J,I)=UNITS2(J)
48 5200 CONTINUE
49 5300 WRITE(6,5400) (CTYPE(J,I),J=1,11),(CCOPY(J,I),J=1,2),
50 X (CMEAS(J,I),J=1,3),CNHU(I),CIPCM(I),CCCM(I),CARV(I),

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51 X (CNURQ(J,I), J=1,5)
52 5400 FORMAT( 3X, 11A2, 11X, 2A2, 2X, 3A2, 4X, F5.0, 3X, F6.2, 3X, F6.3,
53 5500 CONTINUE 3X, F5.1, 5X, 5(1X, F5.0) )
54 IF(NCC .GT. 0) GO TO 5700
55 C
56 WRITE(6,5600)
57 5600 FORMAT( 3X, 4HNONE)
58 C
59 5700 GO TO (4100, 4300, 4500), IC
60 C
61 5800 WRITE(6,5800)
62 5800 FORMAT( 11X, 12HNONE ENTERED )
63 C
64 5900 GO TO 6000
65 C
66 *** HARDWARE ***
67 C
68 C
69 C
70 C
71 6000 NH = NTYPE(IH)
72 NOUT3L = NH+NC+24
73 IF(NOUT3L .LE. LPP) GO TO 6050
74 CALL HEAD
75 NOUT3L = 10+NH
76 6050 WRITE(6,6100)
77 6100 FORMAT( 1X / 1X / 1X /
78 7X, 16H*** HARDWARE *** 21X, 6HREPAIR, 33X, 7HTIME TO /
79 47X, 4HPART, 6X, 7HRETURN, 2X, 6HANNUAL,
80 3X, 4HFAILURES, 2X, 7HREPAIR,
81 7X, 22HUNITS REQUIRED BY YEAR /
82 36X, 4HUNIT, 6X, 8HCOST($)/, 2X, 8HABLE FOR, 3X, 4HLOSS,
83 4X, 8H/HOUR OF, 2X, 7HFAILURE, 7X, 11(2H=) /
84 36X, 7HCOST($), 3X, 8HUNIT/YR., 3X, 6HREPAIR,
85 3X, 7HREPAIR, 1X, 3X, 5HUSAGE, 4X, 7H(HOURS), 4X, 1H1,
86 6X, 1H2, 6X, 1H3, 6X, 1H4, 6X, 1H5 /
87 36X, 4(2H=), 2X, 4(2H=),
88 2X, 4(2H=), 2X, 7H=====, 2X, 4(2H=), 2X, 7H=====,
89 5(2X, 5H=====) )
90 C
91 IF(NH .EQ. 0) GO TO 7200
92 C
93 C MEDIA HARDWARE, CLASS=1
94 C
95 IC = 1
96 WRITE(6,6150)
97 6150 FORMAT( 1X, 14HMEDIA HARDWARE )
98 GO TO 6700
99 C
100 C SPECIAL EQUIPMENT, CLASS=2

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101 C
102 6200 IC = 2
103 WRITE(6,6300)
104 6300 FORMAT( 1X, 17HSPECIAL EQUIPMENT )
105 GO TO 6700
106 C
107 C OVERHEAD HARDWARE, CLASS=3
108 C
109 6400 IC = 3
110 WRITE(6,6500)
111 6500 FORMAT( 1X, 17HOVERHEAD HARDWARE )
112 GO TO 6700
113 6600 GO TO 7500
114 C
115 C HARDWARE "SUBROUTINE"
116 C
117 6700 NHC = 0
118 C
119 C SCAN FOR HARDWARE CLASS "IC"
120 DO 7000 I=1,NH
121 IF( MC(I) .NE. IC) GO TO 7000
122 NHC = NHC+1
123 C
124 C SET CREDIT = ALPHA YES OR ALPHA NO
125 IF( MOD(I) .EQ. 0) INDEX=1
126 IF( MOD(I) .EQ. 1) INDEX=3
127 INDEX1 = INDEX+1
128 CREDIT(1) = YESNO(INDEX)
129 CREDIT(2) = YESNO(INDEX1)
130 C
131 C INPUT METHOD = CALCULATION
132 IF( EIM(I) .EQ. 1)
133 X WRITE(6,6300) (HTYPE(J,I), J=1,15),
134 X HPCU(I), HRCUY(I), CREDIT(1), CREDIT(2), HAAF(I),
135 X EFRPH(I), EAVRT(I), (HNURQ(J,I), J=1,5)
136 6900 FORMAT( 3X, 15A2, 2X, F9.0, 2X, F7.0, 6X, 2A2, 4X, F5.1,
137 X 3X, F7.5, 3X, F7.4, 5(2X, F5.0) )
138 C
139 C INPUT METHOD = THRUPUT
140 IF( EIM(I) .EQ. 2 .OR. EIM(I) .EQ. 0)
141 X WRITE(6,6900) (HTYPE(J,I), J=1,15),
142 X HPCU(I), HRCUY(I), CREDIT(1), CREDIT(2), HAAF(I),
143 X (HNURQ(J,I), J=1,5)
144 6900 FORMAT( 3X, 15A2, 2X, F9.0, 2X, F7.0, 6X, 2A2, 4X, F5.1,
145 X 5X, 3H---, 6X, 3H---, 2X, 5(2X,F5.0) )
146 7000 CONTINUE
147 C
148 IF( NHC .GT. 0) GO TO 7100
149 WRITE( 6,5600)

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1 7100 GO TO (6200, 6400, 6600), IC
2 7200 WRITE(6,5050)
3 GO TO 7500
4 C
5 C
6 C
7 C
8 C
9 7500 NF = NTYPE(I)
10 IF((INOUT3L+1)*NF) .GT. LPP) CALL MEAD
11 WRITE(6,7600)
12 FORMAT(1X / 1X / 1X /
13 7X, 14H*** FACILITIES *** , 32X, 6HMAINT. /
14 46X, 6HSQUARE, 4X, 9HMAN-HOURS, /
15 34X, 27HUNITS REQUIRED BY YEAR /
16 36X, 4HUNIT, 7X, 5MFEET/, 4X, 8H/SQ. FT.,
17 35X, 11(2H=) /
18 36X, 7HCOST(\$), 3X, 8HFAILITY, 2X, 6H/MONTH,
19 34X, 1H1, 6X, 1H2, 6X, 1H3, 6X, 1H4, 6X, 1H5 /
20 34X, 3(2X, 8H=====) , 28X, 5(2X, 5H=====))
21 C
22 IF(NF .EQ. 0) GO TO 8500
23 WRITE(6,7700)
24 FORMAT(1X, 4HNAME)
25 DO 8000 I=1,NF
26 C
27 C INPUT METHOD = CALCULATION
28 IF(GIM(I) .EQ. 1)
29 X WRITE(6,7800) (FTYPE(J,I), J=1,15), FCCPU(I), SSFPE(I),
30 X WRITE(6,7900) (FNURO(J,I), J=1,5)
31 7800 FORMAT(3X, 15A2, 2X, F9.0, 2X, F9.0, 2X, F8.5,
32 29X, 5(2X, F5.0))
33 C
34 C INPUT METHOD = THRU PUT
35 IF(GIM(I) .EQ. 2 .OR. GIM(I) .EQ. 0)
36 X WRITE(6,7900) (FTYPE(J,I), J=1,15), FCCPU(I),
37 X WRITE(6,7900) (FNURO(J,I), J=1,5)
38 7900 FORMAT(3X, 15A2, 2X, F9.0, 4X, 3H---, 7X, 3H---,
39 31X, 5(2X, F5.0))
40 C
41 GO TO 9000
42 8500 WRITE(6,5050)
43 GO TO 9000
44 C
45 C
46 C
47 9000 CONTINUE
48 NH=NTYPE(3)
49 WRITE(6,9010)
50 9010 FORMAT(1X/1X/ 7X,14H*** CMI SYSTEM ***/

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1 99X,22HUNITS REQUIRED BY YEAR/
2 36X,4HUNIT,7X,4HUNIT,48X,11(2M==)/
3 36X,7HCOST(3),3X,9HCAPACITY,42X,1M1,6X,1M2,8X,1M3,6X,1M4,6X,1M5/
4 34X,2(2X,8M=====),38X,5(2X,5M=====)
5 IF(NB.EQ. 0) GO TO 9050
6 WRITE(6,9020)
7 FORMAT(1H,4HNAME)
8 DO 9040 I=1,NR
9   WRITE(6,9030) (RTYPE(I,J),J=1,15),9COST(I),9CAP(I),(BNURQ(J,I),
10    J=1,5)
11   X
12   FORMAT(1H,2X,15A2,2X,F3.0,2X,F3.0,3AX,5(2X,F5.0))
13   CONTINUE
14   GO TO 10000
15   WRITE(6,9050)
16   GO TO 10000
17   CONTINUE
18   RETURN
19   END
20
21
22
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27
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```

51 C
52 C
53 900 CONTINUE
54 CALL INIT(IV,5)
55 CALL INIT(ALOSS,5)
56 CALL INIT(PROC,5)
57 IF(NC.NE.0) GO TO 1500
58 NC = NTYPE(C)
59
60 DO 1400 I=1,NC
61 CARPP = CARP(I)/100.
62 CARVP = CARV(I)/100.
63 IF(CC(I).EQ.1 .OR. CC(I).EQ.2) IROM=1
64 IF(CC(I).EQ.3) IROM=2
65 IF(CC(I).EQ.4) IROM=3
66 GO TO (1200, 1000, 1000), IROM
67
68 * DISPLAY * * SOFTWARE *
69
70 C YEAR 1
71 1000 AV(1) = 0.
72 ALOSS(1) = ROUND0(CARPP*CNURQ(1,I) )
73 PROC(1) = CNURQ(1,I)*ALOSS(1)-AV(1)
74 V4(IROM,2) = V4(IROM,2) +
75 CNMU(1)*CIPCM(I)*(CARVP+1.) +
76 CNMU(1)*CCCM(I)*(PROC(1)+CNURQ(1,I)*CARVP) +
77 PROC(1)*CPC(I)
78
79 C YEARS 2-5
80 DO 1100 J=2,5
81 AV(J) = AV(J-1)+PROC(J-1)-ALOSS(J-1)
82 ALOSS(J) = ROUND0(CARPP*CNURQ(J,I) )
83 PROC(J) = MAX1(( CNURQ(J,I)+ALOSS(J)-AV(J)), 0. )
84
85 C COST = PROCURE. COST FOR INCREASE IN STUDENT LOAD +
86 INITIAL REVISION PREP. COST + REVISION COPY COST +
87 PACKAGING COST
88
89 V4(IROM,J+1) = V4(IROM,J+1) + PROC(J)*CNMU(1)*CCCM(I)
90 + CARVP*CNMU(1)*CIPCM(I)
91 + CARVP*CNMU(1)*CNURQ(J,I)*CCCM(I)
92 + PROC(J)*CPC(I)
93
94 1100 CONTINUE
95 GO TO 1400
96
97 * PRINTED *
98
99 1200 CONTINUE
100 00 1250 J=1,5
101 ALOSS(J) = ROUND0(CARPP*CNURQ(J,I) )

```

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101 PROC(J) = CNURQ(J,I)+ALOSS(J)
102 CONTINUE
103 C
104 V4(IROW,2) = V4(IROW,2) + (CARVP+1.)*
105 (CNMU(I)*CIPCMI)*PROC(I)*CNMU(I)*CCCM(I)
106 X + PROC(I)*CPCCI(I)
107 DO 1300 J=2,5
108 V4(IROW,J+1) = V4(IROW,J+1) + PROC(J)*CNMU(I)*CCCM(I) +
109 CARVP*CNMU(I)*CIPCMI +
110 CARVP*CNMU(I)*PROC(J)*CCCM(I) +
111 PROC(J)*CPCCI(I)
112 1300 CONTINUE
113 1400 CONTINUE
114 GO TO 1500
115 C
116 C
117 C
118 C
119 C
120 1500 CONTINUE
121 NM = NTYPE(M)
*** HARDWARE ***

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```

1  IF(NH.EQ.0) GO TO 2000
2  C
3  DO 1800 I=1,NH
4  IROM = HC(I) + 3
5  CALL HOMRE(I,DEBIT,CREDIT)
6  C COST - YEARS 1-5
7  DO 1700 J=1,5
8  V4(IROM,J+1) = V4(IROM,J) + CREDIT(J)*HPCU(I)*.6
9  X
10  V4(IROM,J+1) = V4(IROM,J) + DEBIT(J)*HISK(I)/12.
11  X
12  1700 CONTINUE
13  1800 CONTINUE
14  GO TO 2000
15  C
16  C
17  C
18  C
19  2000 CALL INITF(AV,5)
20  CALL INITF(PROC,5)
21  IROM = 7
22  NF = NTYPE(F)
23  IF(NF.EQ.0) GO TO 2500
24  C
25  DO 2200 I=1,NF
26  C YEAR 1
27  AV(1) = FNUAV(I)
28  PROC(1) = AMAX1(FNURQ(1,I)-AV(1),0.)
29  V4(IROM,2) = V4(IROM,1) + PROC(1)*FCCPU(I)
30  C YEARS 2-5
31  DO 2100 J=2,5
32  AV(J) = AV(J-1) + PROC(J-1)
33  PROC(J) = AMAX1(FNURQ(J,I) - AV(J),0.)
34  V4(IROM,J+1) = V4(IROM,J) + PROC(J)*FCCPU(I)
35  2100 CONTINUE
36  2200 CONTINUE
37  GO TO 2500
38  C
39  C
40  C
41  C
42  C
43  C
44  C
45  2500 NS = NTYPE(S)
46  IF(NS.EQ.0) GO TO 2900
47  IROM = 9
48  C
49  DO 2700 I=1,NS
50  CALL PAYGR(SPG(I),SPD(I),PG)

```

*** FACILITY CONSTRUCTION ***

*** PAY AND ALLOWANCES ***

STUDENTS

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```
51 DO 2600 J=1,5  
52 V4(IROM,J+1) = V4(IROM,J+1) + SHYRS(J,I)*PG  
53 CONTINUE  
54 2700 CONTINUE  
55 GO TO 2900  
56 C  
57 C INSTRUCTORS  
58 C  
59 2900 NT = NTYPE(I)  
60 IF (NT.EQ. 0) GO TO 3500  
61 IROM = 9  
62 C  
63 DO 3100 I=1,NT  
64 CALL PAYGR(TPG(I),TPD(I),PG)  
65 DO 3000 J=1,6  
66 V4(IROM,J) = V4(IROM,J) + TN(J,I)*PG  
67 3000 CONTINUE  
68 3100 CONTINUE  
69 GO TO 3500  
70 C  
71 C CURRICULUM (IROM=10), HARDWARE (IROM=11),  
72 C FACILITIES (IROM=12), TRAINING ADMIN. (IROM=13),  
73 C BASE. OPER. (IROM=14), MEDICAL (IROM=15)  
74 C  
75 3500 DO 3600 J=1,6  
76 IROM = 10  
77 V4(IROM,J) = (QCOFF*PAYAV(1)+QCAHN*PAYAV(2)+QCCIV*PAYAV(3))/100.  
78 * V2(14,J)  
79 IROM = IROM+1  
80 V4(IROM,J) = (QMOFF*PAYAV(1)+QHAMN*PAYAV(2)+QMCIV*PAYAV(4))/100.  
81 * V2(15,J)  
82 IROM = IROM+1  
83 V4(IROM,J) = (QOFOFF*PAYAV(1)+QFAMN*PAYAV(2)+QFCIV*PAYAV(4))/100.  
84 * V2(16,J)  
85 IROM = IROM+1  
86 V4(IROM,J) = (QAOFF*PAYAV(1)+QAAMN*PAYAV(2)+QACIV*PAYAV(3))/100.  
87 * V2(17,J)  
88 IROM = IROM+1  
89 V4(IROM,J) = (QBOFF*PAYAV(1)+QBAMN*PAYAV(2)+QBCIV*PAYAV(4))/100.  
90 * V2(18,J)  
91 IROM = IROM+1  
92 V4(IROM,J) = (QMOFF*PAYAV(1)+QHAMN*PAYAV(2)+QMCIV*PAYAV(3))/100.  
93 * V2(19,J)  
94 3600 CONTINUE  
95 GO TO 4000  
96 C  
97 C  
98 C  
99 C  
100 C
```

*** PCS COSTS ***

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```

101 C STUDENTS
102 C CONTINUE
103 4000 IROM = 16
104 KROM = 18
105 NS = NTYPE(S)
106 IF(NS.EQ.0) GO TO 5500
107 DO 5100 I=1,NS
108 ISTD = ST(I)
109 IPD = SPO(I)
110 IF(ISTD.EQ.7) GO TO 5100
111 IF(IFLAG.EQ.1) GO TO 4100
112 C IF COURSE DUR. UNDER 20 WEEKS. PCS = STUDENT TYPES 1,3,5 ONLY
113 C IF COURSE DUR. UNDER 20 WEEKS. PCS = STUDENT TYPES 2,4,6
114 C GO TO( 4100, 5100, 4100, 5100, 4100, 5100, 5100), ISTD
115 CALL PCSST(I,PCSOFF,PCSAMN,PCSCIV)
116 DO 5000 J=1,5
117 V4(IROM,J+1) = V4(IROM,J) + (PCSOFF(J)*QCPHOF +
118 PCSAMN(J)*QCPMAY + PCSCIV(J)*QCPHCV)
119 X
120 CONTINUE
121 5000 CONTINUE
122 5100 GO TO 5500
123 C INSTRUCTORS
124 IROM = 17
125 KROM = 21
126 NT = NTYPE(T)
127 IF(NT.EQ.0) GO TO 6500
128 DO 6100 I=1,NT
129 CALL PCSIN(I,AMOVDF,AMOVAM,AMOVCV,EDREQ)
130 DO 5600 J=1,6
131 V4(IROM,J) = V4(IROM,J) + ROUND0(AMOVDF(J))*QCPHOF +
132 ROUND0(AMOVAM(J))*QCPMAY +
133 ROUND0(AMOVCV(J))*QCPHCV
134 X
135 EDUCATION TRAINING
136 C
137 V4(KROM,J) = V4(KROM,J) + EDREQ(J)
138 CONTINUE
139 5600 CONTINUE
140 6100 DO 6200 J=1,6
141 V4(KROM,J) = TETC*ROUND0(V4(KROM,J))
142 CONTINUE
143 6200 GO TO 6500
144 C
145 C
146 C
147 C
148 C
149 C
150 C

```

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*** TOY COSTS ***
151 C
152 C
153 C
154 C
155 C
156 C
TRANSPORTATION AND PER DIEM
157 6500 IF(FLAG.EQ.1) GO TO 6900
158 IFINS.EQ.0160 TO 6900
159 IROW = 18
160 KROW = 19

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1  DO 6650 I=1,NS
2  IST = ST(I)
3  IPO = SPD(I)
4  GO TO(6650,6650,6650,6650,6650,6650,6650),IST
5  CALL TDYST(I, TDYEOF,TDYEH,TDYECV,
6  TDYMOF,TDYHAM,TDYMCV)
7  DO 6600 J=1,5
8  V4(IROM,J+1) = V4(IROM,J+1) + (TDYEOF(J)+TDYEH(J)
9  + TDYECV(J))*QTDYTC
10 V4(KROM,J+1) = V4(KROM,J+1) + (TDYMOF(J)+QTDYOF +
11 TDYHAM(J))*QTDYAM + TDYMCV(J)*QTDYCV)*365.
12 CONTINUE
13 6650 CONTINUE
14 C
15 GO TO 6900
16 C
17 C *** INSTRUCTOR TRAINING ***
18 C
19 C
20 C
21 C
22 C
23 6900 IROM = 20
24 V4(IROM,1) = TIFTC
25 C
26 C
27 C
28 C
29 C
30 C *** MISCELLANEOUS COSTS ***
31 C
32 C
33 C
34 C
35 6900 CONTINUE
36 IROM = 22
37 DO 7000 J=1,5
38 V4(IPOM,J+1) = BSC(J)
39 CONTINUE
40 C
41 C
42 C
43 7050 CONTINUE
44 IROM = 23
45 IF(NH.EQ.0)GO TO 7150
46 DO 7100 I=1,NH
47 DO 7100 J=1,5
48 V4(IROM,J+1) = V4(IROM,J+1) + NHUR(I,I)*HRCUV(I)
49 CONTINUE
50 C

```

FACTORY TRAINING OF INITIAL INSTR. CADRE

EDUCATION TRAINING (SEE PCS COSTS ABOVE)

COMPUTER SERVICE CHARGES

HARDWARE REPAIR PARTS

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51 C      PERSONNEL SUPPLIES
52 C
53 7150   IROW = 24
54       DO 7200 J=1,6
55       V4(IROW,J) = V2(21,J)*QMSCPH
56 7200   CONTINUE
57 C
58 7250   CONTINUE
59 C
60 C      GET COST IN $/K, THEN ROUND TO 1 DECIMAL PLACE
61 C
62       DO 7300 I=1,24
63       DO 7300 J=1,6
64       V4(I,J) = ROUND( V4(I,J)/1000.)
65 7300   CONTINUE
66 C
67 C      CALCULATE COLUMN TOTALS
68 C
69       DO 7400 J=1,6
70       DO 7400 I=1,24
71       V4(25,J) = V4(25,J) + V4(I,J)
72 7400   CONTINUE
73 C
74 C      CALCULATE ROW TOTALS
75 C
76       DO 7500 I=1,25
77       DO 7500 J=1,6
78       V4(I,7) = V4(I,7) + V4(I,J)
79 7500   CONTINUE
80 C
81 C      TOTAL COST LESS STUDENT PAY
82 C
83       DO 7600 J=1,7
84       V4(26,J) = V4(25,J) - V4(18,J)
85 7600   CONTINUE
86 C
87 C      ***PRINT***
88 C
89 C
90 C      CALL HEAD
91 C
92 C
93       WRITE(6,9100)
94 9100   FORMAT( 1H0, 30X, 40HFUNCTIONAL COST SUMMARY (IN THOUSANDS OF,
95       X      9H DOLLARS) / 31X, 24(2H=),1H= / 1X /
96       X      74X, 4HYEAR / 1X /
97       X      54X, 1H0, 9X, 1H1, 9X, 1H2, 9X, 1H3, 9X, 1H4,
98       X      9X, 1H5, 9X, 5HTOTAL /
99       X      49X, 6(3X, 7H=====), 5X, 7H===== )
100 C

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101	WRITE(6,5200) ((V4(I,J), J=1,7), I=1,7)	
102	FORMAT(1X, 24HCOURSEWARE PROCUREMENT /	32X,
103	3X, 14MPRINTED MEDIA, F9.1 /	
104	6(2X, F9.1), 3X, F9.1 /	32X,
105	3X, 14HODISPLAY MEDIA, F9.1 /	
106	6(2X, F9.1), 3X, F9.1 /	37X,
107	3X, 4HSOFTWARE,	
108	6(2X, F9.1), 3X, F9.1 /	
109	1X, 20HWAREWARE PROCUREMENT /	
110	3X, 14HMEDIA HARDWARE,	31X,
111	6(2X, F9.1), 3X, F9.1 /	
112	3X, 17HMSPECIAL EQUIPMENT,	28X,
113	6(2X, F9.1), 3X, F9.1 /	
114	3X, 17HMOVERHEAD HARDWARE,	28X,
115	6(2X, F9.1), 3X, F9.1 /	
116	1X, 21HMFACILITY CONSTRUCTION	26X,
117	6(2X, F9.1), 3X, F9.1)	
118	C	
119	WRITE(6,5300) ((V4(I,J), J=1,7), I=8,15)	
120	FORMAT(1X, 18MPAY AND ALLOWANCES /	37X,
121	3X, 4HSTUDENTS,	
122	6(2X, F9.1), 3X, F9.1 /	34X,
123	3X, 11HINSTRUCTORS,	
124	6(2X, F9.1), 3X, F9.1 /	25X,
125	3X, 20HCURRICULUM PERSONNEL,	
126	6(2X, F9.1), 3X, F9.1 /	15X,
127	3X, 30HWAREWARE MAINTENANCE PERSONNEL,	
128	6(2X, F9.1), 3X, F9.1 /	13X,
129	3X, 32HMFACILITIES MAINTENANCE PERSONNEL,	
130	6(2X, F9.1), 3X, F9.1 /	12X,
131	3X, 33HTRAINING ADMINISTRATIVE PERSONNEL,	
132	6(2X, F9.1), 3X, F9.1 /	13X,
133	3X, 32HBASE OPERATING SUPPORT PERSONNEL,	

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1  X      6(2X, F8.1), 3X, F9.1 /
2  X      3X, 17MEDICAL PERSONNEL,
3  X      6(2X, F8.1), 3X, F9.1 )
4  C
5  WRITE(6,8400) (( V4(I,J),J=1,7), I=16,21 )
6  FORMAT( 1X, 9MPCS COSTS /
7  X, 8MSTUDENTS,
8  X, 6(2X, F8.1), 3X, F9.1 /
9  X, 11INSTRUCTORS,
10 X, 6(2X, F8.1), 3X, F9.1 /
11 X, 9MTOY COSTS /
12 X, 14MTRANSPORTATION,
13 X, 6(2X, F8.1), 3X, F9.1 /
14 X, 20MDESTINATION PER DIEM,
15 X, 6(2X, F8.1), 3X, F9.1 /
16 X, 1X, 19MINSTRUCTOR TRAINING /
17 X, 3X, 48MFACTORY TRAINING OF INITIAL INSTR. CADRE,
18 X, 6(2X, F8.1), 3X, F9.1 /
19 X, 3X, 18MEDUCATION TRAINING,
20 X, 6(2X, F8.1), 3X, F9.1 )
21 C
22 WRITE(6,8500) (( V4(I,J),J=1,7), I=22,26 )
23 FORMAT( 1X, 29MMISCELLANEOUS OPERATING COSTS /
24 X, 24MCOMPUTER SERVICE CHARGES,
25 X, 6(2X, F8.1), 3X, F9.1 /
26 X, 3X, 35MMHARDWARE REPLACEMENT REPAIR PARTS,
27 X, 6(2X, F8.1), 3X, F9.1 /
28 X, 3X, 22MMISCELLANEOUS SUPPLIES,
29 X, 6(2X, F8.1), 3X, F9.1 /
30 X, 48X, 6(3X, 7M=====), 5X, 7M===== / 1X /
31 X, 17MTOTAL COURSE COST,
32 X, 6(1X, F9.1), 2X, F10.1 / 1X /
33 X, 1X, 27MTOTAL COST LESS STUDENT PAY,
34 X, 6(1X, F9.1), 2X, F10.1 )
35 C
36 RETURN
37 END

```

28X,

37X,

34X,

31X,

25X,

5X,

27X,

21X,

10X,

23X,

30X,

20X,

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1  C  SUBROUTINE PAYGR(IPG,IPD,PG)
2  C
3  C
4  C *****RHPK
5  C SUBROUTINE TO LOOK UP PAY FACTOR FROM TABLES
6  C *****RHPK
7  C
8  C COMMON/PAY/ PAY(20,5),PAYAV(5)
9  C
10 C IF(IPG .EQ. 0)GO TO 100
11 C
12 C PG = PAY(IPG,IPD)
13 C
14 C GO TO 200
15 C
16 C PAY GRADE = 0 OR BLANK. USE AVG.
17 C
18 C 100 PG = PAYAV(IPD)
19 C
20 C RETURN
21 C END

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                        SHARED
1  SUBROUTINE FCSST(I, PCSOFF, PCSAMN, PCSCIV)
2  C
3  C
4  C
5  C
6  C
7  C
8  C
9  C
10 C
11 C
12 C
13 C
14 C
15 C
16 C
17 C
18 C
19 C
20 C
21 C
22 C
23 C
24 C
25 C
26 C
27 C
28 C
29 C
30 C
31 C

      PCS -- STUDENT MOVES
      .....RHPK
      .....RHPK

      INTEGER ST, SPD, SPG, SIM
      COMMON/D/ DGC, DMR, DMCD, DEI
      COMMON/S/ ST(75), SPD(75), SPG(75), SIM(75), SNGRAD(7,75),
      X SMYRS(7,75), SENTSI(7,75), SNWASH(7,75)
      DIMENSION PCSOFF(5), PCSAMN(5), PCSCIV(5)

      IPD = SPD(I)
      CALL INITF(PCSOFF,5)
      CALL INITF(PCSAMN,5)
      CALL INITF(PCSCIV,5)
      DO 4500 J=1,5
      SMOVES = SENTSI(J,I) + SNGRAD(J,I) + SNWASH(J,I)
      GO TO ( 4200, 4300, 4400, 4500, 5100), IPD
      4200 PCSOFF(J) = SMOVES
      GO TO 4500
      4300 PCSAMN(J) = SMOVES
      GO TO 4500
      4400 PCSCIV(J) = SMOVES
      GO TO 4500
      4500 CONTINUE
      5100 RETURN
      END

```


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```

1 SUBROUTINE FCSIN(I, AMOVOF, AMOVAM, AMOVCV, EDREQ)
2 C
3 C
4 C
5 C
6 C
7 C
8 C
9 C
10 C
11 C
12 C
13 C
14 C
15 C
16 C
17 C
18 C
19 C
20 C
21 C
22 C
23 C
24 C
25 C
26 C
27 C
28 C
29 C
30 C
31 C
32 C
33 C
34 C
35 C
36 C
37 C
38 C
39 C
40 C
41 C
42 C
43 C
44 C
45 C
46 C
47 C
48 C
49 C
50 C

```

PCS -- INSTRUCTOR MOVES AND EDUC. REQUIREMENTS

INTEGER TT, TPD, TPG
COMMON/T/ TT(25), TPD(25), TPG(25), TSIC(25), TN(6,25), TTR(25),
TNMOB, TIFTC, TETC
X DIMENSION FC(6), TVR(6), EDREQ(6), AMOVOF(6), AMOVAM(6),
X AMOVCV(6)

CALL INITF(AMOVOF,6)
CALL INITF(AMOVAM,6)
CALL INITF(AMOVCV,6)
TPD = TPD(I)
C YEAR 0
FC(I) = 0.0
IF(TNMOB.EQ. 0.) GO TO 5500
FC(I) = (TN(I,1)/TNMOB)*12.
5500 TVR(I) = 0.
C YEARS 1-5
EDREQ(I) = FC(I)
DO 5600 J=2,6
FC(J) = TN(J,I)-TN(J-1,I)
IF(J.EQ.2) FC(J)=TN(J,I)-FC(J-1)
TVR(J) = TN(J,I)*TTR(I)/100.
EDREQ(J) = AMAX1(FC(J),0.)*TVR(J)
5600 CONTINUE
DO 6000 J=1,6
AMOVE = ARS(FC(J))*2.0*TVR(J)
GO TO (5700, 5900, 5900, 5900, 5900, 5900), IPO
C OFFICERS
5700 AMOVOF(J) = AMOVE
GO TO 6000
C AIRMEN
5800 AMOVAM(J) = AMOVE
GO TO 6000
C CIVILIANS
5900 AMOVCV(J) = AMOVE
GO TO 6000
6000 CONTINUE
RETURN
END

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TIME 10.20.54      SHARED      MDL 52 TITLE1
1 SUBROUTINE TITLE1
2 C
3 C
4 C .....RHPK
5 C... TITLE 1 ...
6 C .....RHPK
7 INTEGER U,D,S,T,C,R,M,E,F,G,A,B,O,OO,P,M
8 COMMON/ALL/ NITYPE(20),NTYPE(20),LPP,NLINES,IPAGE,TITLE(39),IFLAG,
9 X U,D,S,T,C,R,M,E,F,G,A,B,O,OO,P,M
10 C
11 CALL HEAD
12 WRITE(6,9010)
13 FORMAT(1H0,49X,10HINPUT DATA/50X,2(5H=====)/1X/1X)
14 WRITE(6,9020)
15 9020 FORMAT(21X,1M1,9X,1M2,9X,1M3,9X,1M4,9X,1M5,9X,1M6,9X,
16 1 1M7,9X,1M8/ 12X,1M1,8X,8(1M0,9X)/ 12X,20(4M,....)/1X/1X)
17 NLINES = 12
18 RETURN
19 END

```

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```

DATE 04/25/77      PROGRAM AIDE      PAGE 30
TIME 10.20.57      SHARED      MDL 23 JUL 72
1  SUBROUTINE TITLE2
2  C
3  C *****RHPK
4  C *** TITLE 2 ***
5  C *****RHPK
6  C
7  C INTEGER U,D,S,T,C,R,H,E,F,G,A,B,O,OO,P,M
8  C COMMON/ALL/ N1TYPE(20),N1TYPE(20),LPP,NLINES,IPAGE,TITLE(39),IFLAG,
9  C   X
10 C   U,D,S,T,C,R,H,E,F,G,A,B,O,OO,P,M
11 C
12 C CALL HEAD
13 C WRITE(6,A010)
14 C 9010 FORMAT(1H0, 31X, 31H ERROR MESSAGES (NOTE1,
15 C   1 35H ONLY ONE ERROR PER CARD IS LISTED)/
16 C   2 36X, 7(2H==) / 1X )
17 C NLINES = 6
18 C RETURN
19 C END

```

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```

DATE: 04/25/77          PROGRAM AIDE          PAGE 31
LINE: 10*21.01         SHARED  MDL 55 INITI
1 SUBROUTINE INITI(IARRAY,N)
2 C .....
3 C .....
4 C SUBROUTINE TO ZERO AN INTEGER ARRAY
5 C .....
6 DIMENSION IARRAY(375)
7 DO 10 I=1,N
8   IARRAY(I) = 0
9 10 CONTINUE
10 RETURN
11 END

```

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```

DATE: 04/25/77      PROGRAM AIDE
LINE: 10,21,01      SHARED  MDL 36 INITF      PAGE 94
1  SUBROUTINE INITF(ARRAY,N)
2  C
3  C .....RHPK
4  C SUBROUTINE TO ZERO A FLOATING ARRAY
5  C .....RHPK
6  DIMENSION ARRAY(375)
7  DO 10 I=1,N
8  ARRAY(I) = 0
9  CONTINUE
10 RETURN
11 END

```

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```
DATE: 04/25/77      PROGRAM AIDE      PAGE 92
TIME: 10.21.02      SHARED      MOL 57 INITA

1 SUBROUTINE INITA(ARRAY,N)
2 C
3 C *****RHPK
4 C SUBROUTINE TO BLANK AN ARRAY *****RHPK
5 C *****RHPK
6 DIMENSION ARRAY(375)
7 DATA BLANK/2H /
8 DO 10 I=1,N
9   ARRAY(I) = 3LANK
10  CONTINUE
11  RETURN
12  END
```

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15 MAY 1977

```
DATE: 04/25/77      PROGRAM AIDE      PAGE 96
LINE: 10.21.02      SHARED      MDL 60.ROUND0
1  C      FUNCTION ROUND0(X)
2  C
3  C .....RMPK
4  C      FUNCTION TO ROUND TO AN INTEGER
5  C .....RMPK
6  C
7  C      ROUND0 = AINT(X) + SIGN(1.,X)*.50002)
8  C      RETURN
9  C      END
```

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```

DATE: 04/25/77      PROGRAM AIDE      PAGE 37
TIME: 10.21.04      MOD 51 ROUND1
                     SHARED
1  FUNCTION ROUND1(X)
2  C .....
3  C .....RHPK
4  C .....
5  C .....FUNCTION TO ROUND TO ONE DECIMAL PLACE
6  C .....RHPK
7  C .....
8  ROUND1 = AINT(X*10. + SIGM(1.,X)*.5002)/10.
9  RETURN
    END

```

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DATE: 04/25/77 PROGRAM AIDE
LINE: 10,21,04 SHARED MDL 62 ERROR PAGE 90

```

1 C SUBROUTINE ERROR(NERR, II, KK)
2 C .....
3 C .....
4 C ..... ERROR MESSAGES .....
5 C .....
6 C .....
7 C .....
8 C .....
9 C .....
10 C .....
11 C .....
12 C .....
13 C .....
14 C .....
15 C .....
16 C .....
17 C .....
18 C .....
19 C .....
20 C .....
21 C .....
22 C .....
23 C .....
24 C .....
25 C .....
26 C .....
27 C .....
28 C .....
29 C .....
30 C .....
31 C .....
32 C .....
33 C .....
34 C .....
35 C .....
36 C .....
37 C .....
38 C .....
39 C .....
40 C .....
41 C .....
42 C .....
43 C .....
44 C .....
45 C .....
46 C .....
47 C .....
48 C .....
49 C .....
50 C .....

```

IF(NLINES .EQ. 0) CALL TITLE2
IF(NLINES .GE. LP2) CALL TITLE2
GO TO(10,20,30,40,50,60,70,80,90,100,110,120,130,140,150,160,
1 170,180,190,200,210,220,230,240,250,260,270,280,290,300,
2 310,320,330,340,350,360,370,380,390,400,410,420,430,440,
3 450),NERR

WRITE(6,15)II, KK
FORMAT(2H0*, 3HILLEGAL INPUT FORMAT ON CARD *, I3,
1 454, CARD EXCLUDED FROM MODEL. LEGAL RANGE = 01-12,1M.)
GO TO 990

WRITE(6,25)II, KK
FORMAT(2H0*, 45HMORE THAN 1 COURSE DURATION CARD ENCOUNTERED.,
1 7H CARD *, I3, 17H WAS USED. CARD *, I3,
2 21H EXCLUDED FROM MODEL.)
GO TO 990

WRITE(6,35)KK
FORMAT(2H0*, 37HILLEGAL STUDENT PERSONNEL DESIGNATOR.,
1 24H LEGAL RANGE = 01-05, CARD *, I3, 21H EXCLUDED FROM MODEL.)
GO TO 990

WRITE(6,45)KK
FORMAT(2H0*, 49HILLEGAL STUDENT TYPE. LEGAL RANGE = 01-07, CARD *,
1 I3, 21H EXCLUDED FROM MODEL.)
GO TO 990

WRITE(6,55)II, KK
FORMAT(2H0*, 44HDOUBLE STUDENT TYPE-PERSONNEL DESIGNATOR.,
1 17HPAY GRADE. CARD *, I3, 17H WAS USED. CARD *, I3,
2 21H EXCLUDED FROM MODEL.)
GO TO 990

WRITE(6,65)KK
FORMAT(2H0*, 40HILLEGAL INSTRUCTOR PERSONNEL DESIGNATOR.,
1 24H LEGAL RANGE = 01-04, CARD *, I3, 21H EXCLUDED FROM MODEL.)
GO TO 990

WRITE(6,75)II, KK
FORMAT(2H0*, 48HDOUBLE PERSONNEL DESIGNATOR-PAY GRADE.,
1 24H ON INSTRUCTOR INPUT. CARD *, I3, 17H WAS USED. CARD *,
2 I3, 21H EXCLUDED FROM MODEL.)
GO TO 990

WRITE(6,85)KK
FORMAT(2H0*, 32HCOURSEWARE ID MISSING OR INVALID,
1 40H ON COURSEWARE PROCUREMENT INPUT. CARD *, I3,

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LINE: 10, 21, 04
PROGRAM AIDE
MDL 52 ERROR
PAGE 99

51 2 21M EXCLUDED FROM MODEL.)
52 GO TO 990
53 WRITE(6,95)II,KK
54 90 FORMAT(2H0*, 37H)DUPLICATE COURSEWARE ID ON COURSEWARE,
55 95 1 26H PROCUREMENT INPUT. CARD *, I3, 10M WAS USED.,
56 2 7M CARD *, I3, 21M EXCLUDED FROM MODEL.)
57 GO TO 990
58 100 WRITE(6,105)KK
59 105 FORMAT(2H0*, 32H)COURSEWARE ID MISSING OR INVALID,
60 1 37H ON CURRICULUM MANPOWER INPUT. CARD *, I3,
61 2 21M EXCLUDED FROM MODEL.)
62 GO TO 990
63 110 WRITE(6,115)II,KK
64 115 1 37H ON CURRICULUM COURSEWARE ID,
65 1 37H ON CURRICULUM MANPOWER INPUT. CARD *, I3,
66 2 17M WAS USED. CARD *, I3, 21M EXCLUDED FROM MODEL.)
67 GO TO 990
68 120 WRITE(6,125)KK
69 125 1 39H EQUIPMENT ID MISSING OR INVALID,
70 1 39H ON HARDWARE PROCUREMENT INPUT. CARD *, I3,
71 2 21M EXCLUDED FROM MODEL.)
72 GO TO 990
73 130 WRITE(6,135)II,KK
74 135 1 39H ON HARDWARE ID ON HARDWARE,
75 1 26H PROCUREMENT INPUT. CARD *, I3, 10M WAS USED.,
76 2 7M CARD *, I3, 21M EXCLUDED FROM MODEL.)
77 GO TO 990
78 140 WRITE(6,145)KK
79 145 1 39H ON HARDWARE ID MISSING OR INVALID,
80 1 39H ON HARDWARE MTC MANPOWER INPUT. CARD *,
81 2 13, 21M EXCLUDED FROM MODEL.)
82 GO TO 990
83 150 WRITE(6,155)II,KK
84 155 1 39H ON HARDWARE ID ON HARDWARE,
85 1 27H MTC MANPOWER INPUT. CARD *, I3,
86 2 17M WAS USED. CARD *, I3, 21M EXCLUDED FROM MODEL.)
87 GO TO 990
88 160 WRITE(6,165)KK
89 165 1 35H FACILITY ID MISSING OR INVALID ON,
90 1 35H FACILITY PROCUREMENT INPUT. CARD *, I3,
91 2 21M EXCLUDED FROM MODEL.)
92 GO TO 990
93 170 WRITE(6,175)II,KK
94 175 1 39H ON HARDWARE ID ON FACILITY,
95 1 26H PROCUREMENT INPUT. CARD *, I3,
96 2 17M WAS USED. CARD *, I3, 21M EXCLUDED FROM MODEL.)
97 GO TO 990
98 190 WRITE(6,195)KK
99 195 1 36H FACILITY ID MISSING OR INVALID ON,
100 1 36H FACILITY MTC MANPOWER INPUT. CARD *, I3,

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DATE 04/25/77
TIME 18.21.00
PROGRAM AIDE
MDL 63 SPOLLER15
PAGE 100

```

1 2 21M EXCLUDED FROM MODEL.)
2 GO TO 990
3 190 WRITE(6,195)II,KK
4 195 FORMAT(2H0, 33H0DUPLICATE FACILITY ID ON FACILITY,
5 1 27M MTC MANPOWER INPUT. CARD *, 13, 10M WAS USED.,
6 2 7M CARD *, 13, 21M EXCLUDED FROM MODEL.)
7 GO TO 990
8 200 WRITE(6,205)KK
9 205 FORMAT(2H0, 42HINVALID PERSONNEL TYPE ON ADMIN..BASE OP.,
10 1 50HMD MEDICAL PERSONNEL INPUT. LEGAL VALUES = 13-15.,
11 2 7M CARD *, 13, 21M EXCLUDED FROM MODEL.)
12 GO TO 990
13 210 WRITE(6,215)II,KK
14 215 FORMAT(2H0, 44H0DUPLICATE PERSONNEL TYPE ON ADMIN..BASE OP.,
15 1 35HMD MEDICAL PERSONNEL INPUT. CARD *, 13,
16 2 17M WAS USED. CARD *, 13, 21M EXCLUDED FROM MODEL.)
17 GO TO 990
18 220 WRITE(6,225)II,KK
19 225 FORMAT(2H0, 36HMORE THAN 1 COMPUTER SERVICE CHARGES,
20 1 25H CARD ENCOUNTERED. CARD *, 13,
21 2 17M WAS USED. CARD *, 13, 21M EXCLUDED FROM MODEL.)
22 GO TO 990
23 230 WRITE(6,235)KK
24 235 FORMAT(2H0, 35HILLEGAL PERSONNEL DESIGNATOR ON PAY,
25 1 45H FACTOR OVERRIDE INPUTS. LEGAL RANGE = 01-05.,
26 2 7M CARD *, 13, 21M EXCLUDED FROM MODEL.)
27 GO TO 990
28 240 WRITE(6,245)II,KK
29 245 FORMAT(2H0, 31H0DUPLICATE PERSONNEL DESIGNATOR-,
30 1 47HPAY GRADE ON PAY FACTOR OVERRIDE INPUTS. CARD *,
31 2 13, 17M WAS USED. CARD *, 13, 21M EXCLUDED FROM MODEL.)
32 GO TO 990
33 250 WRITE(6,255)II,KK
34 255 FORMAT(2H0, 10HMORE THAN 1 OFF/AIR/CIV OVERRIDES CARD,
35 1 20H ENCOUNTERED. CARD *, 13,
36 2 17M WAS USED. CARD *, 13, 21M EXCLUDED FROM MODEL.)
37 GO TO 990
38 260 WRITE(6,265)KK
39 265 FORMAT(2H0, 30HILLEGAL PERSONNEL DESIGNATOR-PAY GRADE,
40 1 30M PAIR ON STUDENT INPUT. CARD *, 13,
41 2 21M EXCLUDED FROM MODEL.)
42 GO TO 990
43 270 WRITE(6,275)KK
44 275 FORMAT(2H0, 30HILLEGAL PERSONNEL DESIGNATOR-PAY GRADE,
45 1 33M PAIR ON INSTRUCTOR INPUT. CARD *, 13,
46 2 21M EXCLUDED FROM MODEL.)
47 GO TO 990
48 280 WRITE(6,285)KK
49 285 FORMAT(2H0, 39HILLEGAL PERSONNEL DESIGNATOR-PAY GRADE,
50 1 43M PAIR ON PAY FACTOR OVERRIDE INPUTS. CARD *, 13,

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DATE: 04/25/77
LINE: 1021-008
PROGRAM AIDE
SHARED
MOL 53 SPOLLER12
PAGE 101

51 2 21H EXCLUDED FROM MODEL.)
52 GO TO 990
53 WRITE(6,295)
54 295 FORMAT(2H0*, 35HSTUDENT ENTRY INTERVAL EQUALS ZERO.,
55 1 17H JOB TERMINATED.)
56 GO TO 990
57 300 WRITE(6,305)II
58 305 FORMAT(2H0*, 46HONE OR MORE OF THE OFF-AIR-CIV DISTRIBUTIONS,
59 1 30H DOES NOT TOTAL 100 ON CARD *, I3,
60 2 25H. TABLE VALUES WERE USED.)
61 GO TO 990
62 310 WRITE(6,315)KK
63 315 FORMAT(2H0*, 30HILLEGAL VALUE FOR INPUT METHOD,
64 1 47H ON STUDENT INPUT. LEGAL VALUES = 00.01. CARD *, I3,
65 2 21H EXCLUDED FROM MODEL.)
66 GO TO 990
67 320 WRITE(6,325)KK
68 325 FORMAT(2H0*, 39HILLEGAL INSTRUCTOR TYPE. LEGAL VALUES =,
69 1 14H 08.09. CARD *, I3, 21H EXCLUDED FROM MODEL.)
70 GO TO 990
71 330 WRITE(6,335)KK
72 335 FORMAT(2H0*, 27HILLEGAL COURSEWARE CLASS ON,
73 1 52H COURSEWARE PROCUREMENT INPUT. LEGAL VALUES = 01-03.,
74 2 7H CARD *, I3, 21H EXCLUDED FROM MODEL.)
75 GO TO 990
76 340 WRITE(6,345)KK
77 345 FORMAT(2H0*, 46HILLEGAL VALUE FOR INPUT METHOD ON CURRICULUM,
78 1 45H MANPOWER INPUT. LEGAL VALUES = 01.02. CARD *, I3,
79 2 21H EXCLUDED FROM MODEL.)
80 GO TO 990
81 350 WRITE(6,355)KK
82 355 FORMAT(2H0*, 25HILLEGAL HARDWARE CLASS ON,
83 1 50H HARDWARE PROCUREMENT INPUT. LEGAL VALUES = 01-03.,
84 2 7H CARD *, I3, 21H EXCLUDED FROM MODEL.)
85 GO TO 990
86 360 WRITE(6,365)KK
87 365 FORMAT(2H0*, 46HILLEGAL VALUE FOR INPUT METHOD ON HARDWARE MTC,
88 1 45H MANPOWER INPUT. LEGAL VALUES = 01.02. CARD *, I3,
89 2 21H EXCLUDED FROM MODEL.)
90 GO TO 990
91 370 WRITE(6,375)KK
92 375 FORMAT(2H0*, 42HILLEGAL VALUE FOR INPUT METHOD ON FACILITY,
93 1 49H MTC MANPOWER INPUT. LEGAL VALUES = 01.02. CARD *, I3,
94 2 21H EXCLUDED FROM MODEL.)
95 GO TO 990
96 380 WRITE(6,385)KK
97 385 FORMAT(2H0*, 46HILLEGAL VALUE FOR INPUT METHOD ON ADMIN., BASE,
98 1 56H OP., AND MEDICAL PERSONNEL INPUT. LEGAL VALUES = 01.02.,
99 2 7H CARD *, I3, 21H EXCLUDED FROM MODEL.)

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DATE: 8/25/77
TIME: 10.22.54
PROGRAM AIDE
SHARED MDL 54 SPOLLER15 PAGE 102

```
1 GO TO 990
2 390 WRITE(6,395)KK
3 395 FORMAT(2H0*, 35HINCONSISTENT STUDENT TYPE-PERSONNEL,
4 1 36H DESIGNATOR ON STUDENT INPUT. CARD *, I3,
5 2 21H EXCLUDED FROM MODEL.)
6 GO TO 990
7 400 WRITE(6,405)KK
8 405 FORMAT(2H0*, 34HILLEGAL VALUE FOR CREDIT OPTION ON,
9 1 51H HARDWARE PROCUREMENT INPUT. LEGAL VALUES = 0 OR 1.,
10 2 7H CARD *, I3, 21H EXCLUDED FROM MODEL.)
11 GO TO 990
12 410 WRITE(6,415)II,KK
13 415 FORMAT(2H0*, 40HMORE THAN 1 MISCELLANEOUS OVERRIDES CARD,
14 1 20H ENCOUNTERED. CARD *, I3,
15 2 17H WAS USED. CARD *, I3, 21H EXCLUDED FROM MODEL.)
16 GO TO 990
17 420 WRITE(6,425)
18 425 FORMAT(4H0***, 41H NO LEGAL COURSE DURATION CARD WAS FOUND.,
19 1 20H JOB TERMINATED. ***)
20 GO TO 990
21 430 WRITE(6,435)II,KK
22 435 FORMAT(2H0*, 30HTHE MAXIMUM NO. OF FORMAT TYPE, I3,
23 1 28H INPUTS WAS EXCEEDED. CARD *, I3,
24 2 21H EXCLUDED FROM MODEL.)
25 GO TO 990
26 440 WRITE(6,445)
27 445 FORMAT(2H0*, 43HGRADUATE COURSE DURATION EXCEEDS TWO YEARS.,
28 1 20H PROGRAM TERMINATED.)
29 GO TO 990
30 450 WRITE(6,455)
31 455 FORMAT(2H0*, 41HWHOSHOUT COURSE DURATION EXCEEDS ONE YEAR.,
32 1 20H PROGRAM TERMINATED.)
33 GO TO 990
34 C*****RHPK
35 990 CONTINUE
36 NLINES = NLINES+2
37 RETURN
38 END
```

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15 MAY 1977

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15 MAY 1977

MCDONNELL DOUGLAS ASTRONAUTICS COMPANY - EAST

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DATE= 04/25/77          PROGRAM AIDE          PAGE 102
TIME= 10:22:49          SHARED              MDL 57 ALDEA

      PROGRAM AIDEA
1  C
2  C
3  C *****
4  C *****WRITE LESSON DESCRIPTORS,CHI SYSTEM,MISC.*****
5  C *****
6  C *****
7  C *****
8  C *****
9  C *****
10 C *****
11 C *****
12 C *****
13 C *****
14 C *****
15 C *****
16 C *****
17 C *****
18 C *****
19 C *****
20 C *****
21 C *****
22 C *****
23 C *****
24 C *****
25 C *****
26 C *****
27 C *****
28 C *****
29 C *****
30 C *****
31 C *****
32 C *****
33 C *****
34 C *****
35 C *****
36 C *****
37 C *****
38 C *****
39 C *****
40 C *****
41 C *****
42 C *****
43 C *****
44 C *****
45 C *****
46 C *****
47 C *****
48 C *****
49 C *****
50 C *****

      COMMON/ALL/  N1TYPE(20),N1TYPE(20),LPP,NLINES,IPAGE,IITLE(39),IFLAG,
      X            U,D,S,T,C,R,H,E,F,G,A,B,0,00,P,M
      COMMON/BI/   BSC(5),BID(3),BTYPE(3),B,0,00,P,M
      COMMON/ABD1/ TSIR(25),HSPU(75),HLRHU(75),FSPU(25),
      X            CLRC(75),CSPC(75),TPOI
      COMMON/ABD1A/SVAR(75),SVARNM(3),NSVAR
      COMMON/ABD2/ MID(75),M1TYPE(75),MVAR(75),M1L,LDES,
      X            MVARNM(11),CONST,MCOEF(14),TVAL(11)
100 CONTINUE

      C CHECK THAT LESSON DATA HAS BEEN ENTERED
110 IF(N1TYPE(M).GT. 0) GO TO 200
      WRITE(6,110)
110 FORMAT(1H,51H*****PROGRAM TERMINATING--NO LESSON DESCRIPTORS*****
      STOP
120 CONTINUE

      C CHECK TO SEE IF OLD COURSE TIME WAS ENTERED
      IF(TPOI.GT. 0) GO TO 300
      WRITE(6,210)
210 FORMAT(1H,42H*****OLD COURSE DURATION DATA MISSING*****
      CONTINUE

      C WRITE LESSON DESCRIPTORS
      CALL HEAD
      WRITE(6,310)
310 FORMAT(1H,58X,19HLESSON DESCRIPTORS)
      WRITE(6,320) (MVARNM(K),K=1,LDES)
320 FORMAT(1H,01X,12HID,5X,4HNAME,10X,11(4X,A6) )
      KM=N1TYPE(1H)
      DO 340 I=1,KM
340 I=1,KM
      WRITE(6,330) I,(M1TYPE(I,J),J=1,10),(MVAR(I,J),J=1,LDES)
330 FORMAT(1H,13X,10A2,11(2X,F6,1,2X))
      CONTINUE
340 CONTINUE
340 CONTINUE
340 CONTINUE
      RETURN
      END

```

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DATE: 04/25/77 PROGRAM AIDE
LINE: 10,22,50 SHARED VOL TO AIDE PAGE 10Z

```
51 DO 300 I=1,KS  
52 ENT(I)=0.0  
53 DO 250 J=1,5  
54 ENT(I)=ENT(I)+SENTS(J,I)  
55 250 CONTINUE  
56 TOTENT=TOTENT+ENT(I)  
57 300 CONTINUE  
58 C  
59 C COMPUTE AVERAGE TIME TO COMPLETE THE COURSE,WEIGHTED BY ENTRANTS  
60 C  
61 DGCD=0.0  
62 DO 400 I=1,KS  
63 DGCD=DGCD+ENT(I)*TIME(I,KOLSUM)  
64 400 CONTINUE  
65 DGCD=DGCD/TOTENT  
66 C  
67 C ESTIMATE THAT WASHOUTS ARE COMPLETING 25% OF THE COURSE  
68 C  
69 C  
70 C  
71 C  
72 C COMPUTE TIME SAVING  
73 C  
74 IF(TPOI.EQ.0) GO TO 410  
75 TS=((TPOI-DGCD)/TPOI)*100.0  
76 410 CONTINUE  
77 C  
78 C OUTPUT THE RESULTS  
79 C  
80 CALL HEAD  
81 WRITE(6,910)  
82 910 FORMAT(1H0,45X,19H**COURSE COMPLETION DATA (IN HOURS)**)  
83 NREP=KS/20 *1  
84 DO 950 I=1,NREP  
85 K1=20*(I-1)+1  
86 K2=20*I  
87 IF(K2.GT. KS) K2=KS  
88 WRITE(6,920) SVARN(K1),(SVAR(K,I),K=K1,K2)  
89 920 FORMAT(1H0,1X,17HSTUDENT VARIABLES,2X,A6,1X,20F5.0)  
90 IF(NSVAR.EQ.1)GOTO 923  
91 DO 922 L=2,NSVAR  
92 WRITE(6,921) SVARN(L),(SVAR(K,L),K=K1,K2)  
93 922 CONTINUE  
94 923 CONTINUE  
95 923 CONTINUE  
96 WRITE(6,925)  
97 925 FORMAT(1H,6HLESSON,6X,4HNAME )  
98 DO 940 J=1,KW  
99 WRITE(6,930) J,(TYPE(J,K),K=1,10),(TIME(K,J),K=K1,K2)  
100 930 FORMAT(1H,13X,10A2,5X,20F5.1)
```

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DATE: 04/25/77
LINE: 18,22,50

PROGRAM AIDE
MDL 70 AIDER

SHARED

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```

101 940 CONTINUE
102 950 CONTINUE
103 C
104 C OUTPUT TIME TO COMPLETE THE COURSE BY STUDENT TYPE
105 C
106 WRITE(6,952) (SVARNMII,I=1,NSVAP)
107 952 FORMAT(1H,1X,10HSTUDENT VARIABLES,5X,6HCOURSE / 1H ,
108 X 2X,10HCOMPLETION / 1H ,3(1X,A6),3X,10HTIME (HRS))
109 DO 956 I=1,KS
110 WRITE(6,954) (SVAR(I,L),L=1,NSVAR),TIME(I,KOLSUM)
111 954 FORMAT(1H ,2X,3(F4.0,3X),1X,F7.1)
112 956 CONTINUE
113 C
114 C CHECK FOR NEGATIVE LESSON TIMES, IF FOUND, SET DGCD EQUAL TO
115 C MINUS ONE TO TERMINATE THE PROGRAM
116 C
117 INEG=0
118 DO 965 I=1,KS
119 DO 965 J=1,KM
120 IF(TIME(I,J) .GE. 0.0) GO TO 965
121 INEG=INEG+1
122 WRITE(6,963) I,J
123 963 FORMAT(1H ,44H***NEGATIVE LESSON TIME COMPUTED FOR LESSON ,
124 X 14,15H STUDENT TYPE ,13,4H ***)
125 965 CONTINUE
126 IF(INEG .GT. 0) DGCD=-1.0
127 WRITE(6,968) DGCD
128 968 FORMAT(1H,1H ,33HAVERAGE COURSE COMPLETION TIME IS,F7.2,
129 X 7H HOURS)
130 IF(TPOI .EQ. 0) GO TO 980
131 WRITE(6,979) TS
132 979 FORMAT(1H,1H ,22HAVERAGE TIME SAVING IS,F7.1,9H PERCENT)
133 980 CONTINUE
134 RETURN
135 END

```

```

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-----
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-----

1 SUBROUTINE AIDEC
2
3 C *****
4 C ***** ESTIMATE RESOURCES REQUIRED *****
5 C *****
6
7 INTEGER U,D,S,T,C,R,H,E,F,G,A,I,O,0,P,M
8
9 INTEGER ST,SPO,SPG,SIM
10
11 INTEGER TI,TPD,TPG
12
13 INTEGER CID,CC
14
15 INTEGER MID,MC,MOD
16
17 INTEGER EIDX,EIMX,EID,EIM
18
19 INTEGER FID
20
21 INTEGER BID
22
23 COMMON/ALL/ NITYPE(20),NTYPE(20),LPP,NLINES,IPAGE,ITITLE(39),IFLAG,
24
25 U,D,S,T,C,R,H,E,F,G,A,I,O,0,P,M
26
27 DCCO,DMP,DMO,DEI
28
29 ST(75),SPO(75),SPG(75),SIM(75),SNGRAD(7,75),
30
31 SMYS(7,75),SENTS(7,75),SNMASH(7,75)
32
33 TT(25),TPD(25),TPG(25),TSIIC(25),TN(6,25),TTR(25),
34
35 TNMOR,TIFTC,TEIC
36
37 CIO(75),CC(75),CTYPE(11,75),CCOPY(2,75),CHEAS(3,75),
38
39 CNURO(15,75),CNHU(75),CIPCM(75),CCCM(75),CPC(75),
40
41 CARV(75),CARP(75)
42
43 MID(75),MC(75),MOD(75),MIVPE(15,75),HNURQ(5,75),
44
45 HNURV(75),HPCU(75),HAAF(75),HRCUY(75),HISP(75),
46
47 EIDX(75),EIMX(75),EID(75),EIM(75),EDURX(5,75),
48
49 EFRPHX(75),EAVRTX(75),ENPX(5,75),EDJR(5,75),
50
51 EFRPH(75),EAVRT(75),ENP(5,75)
52
53 FID(25),FTYPE(15,25),FCCPU(25),FNURQ(5,25),
54
55 FNURV(25)
56
57 BSC(5),BID(3),BTYPE(3,15),BCAP(3),BCOST(3),BNURQ(5,1)
58
59 DCOFF,QCANN,QCCIV, QHOFF,QHAMN,QMCIV,
60
61 QOFF,QFAMN,QFCIV, QAOFF,QAHMN,QACIV,
62
63 QOFF,QBAMN,QBCIV, QMOFF,QHAMN,QMCIV,
64
65 QAHMN,QAOHNM,QATOPM,QTHPD,QMSCPM,QCPHOF,QCPHAM,QCPHCV,
66
67 QDVTG,QDVOF,QDNYAM,QDNYCV
68
69 COMMON/AIDEL/ TSIR(25),HSPU(75),HLRH(75),FSPU(25),
70
71 CLRC(75),CSPC(75),TPDI
72
73 DIMENSION AENRL(5)
74
75 C THIS SUBROUTINE IS USED TO COMPUTE THE QUANTITY OF EACH TYPE
76
77 C INSTRUCTIONAL RESOURCE REQUIRED TO SUPPORT THE COURSE
78
79 C COMPUTE THE AVERAGE ENROLLMENT EACH YEAR. THIS IS EQUAL TO THE
80
81 C TOTAL NUMBER OF STUDENT HANYEARS GENERATED IN EACH YEAR
82
83
84 CALL INIT(AENRL,5)
85
86 KS=NTYPE(5)
87
88 DO 10 I=1,5
89
90   DO 10 J=1,KS
91
92     AENL(I)=AENRL(I)*SMYPS(I,J)
93
94   END DO
95
96 END DO
97
98
99
100

```

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51 10 CONTINUE
52 C OVERHEAD FACTORS TO ALLOW FOR ENROLLMENT FLUCTUATIONS
53 TVHND=1.25
54 MOVHND=1.25
55 FOVHND=1.25
56 BOVHND=1.25
57 COVHND=1.25
58 100 CONTINUE
59 C COMPUTE THE NUMBER OF INSTRUCTORS REQUIRED EACH YEAR. TSIP IS
60 C THE NUMBER OF STUDENTS PER INSTRUCTOR
61 C
62 KT=TYPE(I)
63 IF (KT.EQ. 0) GO TO 200
64 DO 110 I=2,6
65 DO 110 J=1,KT
66 TN(I,J)=AINT(TOVHND*AEHL(I-1)/TSIP(J))+1.0
67 110 CONTINUE
68 200 CONTINUE
69 C COMPUTE THE HARDWARE QUANTITIES REQUIRED EACH YEAR
70 C
71 KW=TYPE(M)
72 KH=TYPE(H)
73 IF (KH.EQ. 0) GO TO 300
74 DO 210 I=1,3
75 DO 210 J=1,KH
76 HNRQ(I,J)=AINT((MOVHND*AEHL(I)*HLRHU(J)/
77 (KW*HSPU(J)))+1.0
78 Y
79 210 CONTINUE
80 C COMPUTE THE INITIAL STOCK OF HARDWARE REQUIRED. THIS IS SET
81 C EQUAL TO A TWO MONTHS SUPPLY
82 DO 220 I=1,KH
83 HISR(I)=ROUND(HNRQ(I,1)/5.0)
84 220 CONTINUE
85 C COMPUTE THE DAILY UTILIZATION RATE
86 UTIL=OTHPD/FOVHND
87 DO 230 I=1,5
88 DO 230 J=1,KH
89 EDURX(I,J)=UTIL
90 230 CONTINUE
91 C COMPUTE FACILITIES REQUIRED
92 KF=TYPE(F)
93 IF (KF.EQ. 0) GO TO 400
94 DO 310 I=1,5
95 DO 310 J=1,KF
96 FNRQ(I,J)=AINT((FOVHND*AEHL(I)/FSPU(J))+1.0
97 310 CONTINUE
98 400 CONTINUE
99 C COMPUTE QUANTITIES REQUIRED. FOR PROGRAMMED TEXT, OUT2 COMPUTES
100 C THE QUANTITY REQUIRED

```

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101 KC=TYPE(C)
102 IF(KC.EQ.0) GO TO 500
103 DO 420 I=1,5
104 DO 420 J=1,KC
105 IF((CC(J).EQ.1).OR.(CC(J).EQ.2)) GO TO 420
106 CNURQ(I,J)=AINT(COVHQ*CLRC(J)*AENR(I)/
107 (KW*CSPC(J)))+1.0
108 X
109 420 CONTINUE
110 500 CONTINUE
111 C COMPUTER HARDWARE QUANTITIES REQUIRED
112 KB=TYPE(B)
113 IF(KB.EQ.0) GO TO 600
114 DO 520 I=1,5
115 C VARIABLE CMITPM IS THE NUMBER OF CM TRANSACTIONS PER HOUR
116 CMITPM=ROWHQ*AENR(I)*KW/DCGD
117 DO 510 J=1,2
118 510 CONTINUE
119 520 CONTINUE
120 CMITPM=ROWHQ*CMITPM/BCAP(I)+1.0
121 C COMPUTER SYSTEM COST
122 DO 540 I=1,5

```

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1      BSC(1)=0.0
2      DO 530 J=1,3
3          BSC(1)=BSC(1)+8*NURO(I,J)*BCOST(J)
4      CONTINUE
5      530 CONTINUE
6      600 CONTINUE
7      RETURN
8      END
9      BLOCK DATA
10     C .....
11     C .....RMPK
12     C *** PROGRAM CONSTANTS ***
13     C .....RMPK
14     C .....
15     C DIMENSION QCONST(30)
16     C
17     C COMMON/O/ QCOFF,QCANH,QCCIV, QHOFF,QAHNH,QHCIV,
18     X QCOFF,QCANH,QCCIV, QHOFF,QAHNH,QHCIV,
19     X QCOFF,QCANH,QCCIV, QHOFF,QAHNH,QHCIV,
20     C
21     X QAHNPM,QADPM,QATDPM,QTHPD,QMSCPM,QCPMH,QCPMCV,
22     X QDYTC,QDYOF,QDYAM,QDYCV
23     C
24     C
25     C
26     C
27     C EQUIVALENCE (QCOFF,QCONST(1))
28     DATA QCOFF/ 0.0 /, QCANH/ 53.0 /, QCCIV/ 37.0 /,
29     X QHOFF/ 2.0 /, QAHNH/ 72.0 /, QHCIV/ 25.0 /,
30     X QCOFF/ 0.0 /, QCANH/100.0 /, QCCIV/ 0.0 /,
31     X QHOFF/ 6.0 /, QAHNH/ 39.0 /, QHCIV/ 53.0 /,
32     X QCOFF/ 2.0 /, QAHNH/ 64.0 /, QCCIV/ 34.0 /,
33     X QHOFF/ 20.0 /, QAHNH/ 30.0 /, QHCIV/ 0.0 /,
34     X QAHNPM/121.0 /, QADPM/162.0 /, QATDPM/ 6.0 /, QTHPD/21.74 /,
35     X QMSCPM/112.0 /, QCPMH/879.0 /, QCPMCV/224.0 /,
36     X QCPMCV/879.0 /, QDYTC/ 95.0 /,
37     X QDYOF/ 11.0 /, QDYAM/ 4.0 /, QDYCV/ 21.0 /
38     C
39     END

```


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1 *FOR
2 OVERLAY(AIDE,0,0)
3 AIDE
4 BLKCAT.
5 OVERLAY(READC,1,0)
6 READC
7 OVERLAY(READS,2,0)
8 READS
9 OVERLAY(READT,3,0)
10 READT
11 OVERLAY(READC,4,0)
12 READC
13 OVERLAY(READR,5,0)
14 READR
15 OVERLAY(READH,6,0)
16 READH
17 OVERLAY(READE,7,0)
18 READE
19 OVERLAY(READF,10,0)
20 READF
21 OVERLAY(READG,11,0)
22 READG
23 OVERLAY(READA,12,0)
24 READA
25 OVERLAY(READB,13,0)
26 READB
27 OVERLAY(READC,14,0)
28 READC
29 OVERLAY(READD,15,0)
30 READD
31 OVERLAY(READP,16,0)
32 READP
33 OVERLAY(READM,17,0)
34 READM
35 OVERLAY(AIDEA,20,0)
36 AIDEA
37 OVERLAY(AIDEB,21,0)
38 AIDEB

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50	16	0 LESSON FOUR	49	55	69	2.6	2.7	21	9	28	1.2	1.5
51	16	0 LESSON FIVE	49	55	69	2.5	2.7	21	8	28	1.2	1.5
52	16	0 LESSON SIX	49	55	69	2.5	2.7	21	4	28	1.2	1.5
53	16	0 LESSON SEVEN	49	55	69	2.6	2.7	21	9	28	1.2	1.5
54	16	0 LESSON EIGHT	49	55	69	2.6	2.7	21	8	28	1.2	1.5
55	16	0 LESSON NINE	49	55	69	2.6	2.7	21	8	28	1.2	1.5
56	16	0 LESSON TEN	49	55	69	2.6	2.7	21	9	28	1.2	1.5
57	99											
58	40R											

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